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ELECTROCUTIONS.

It will be remembered that the last Ohio Legislature passed a measure which went into effect on the 1st of July, legalizing electrical executions in that State. The making of a law is one thing and fulfilling its requirements are quite another, as the Ohio penitentiary officials are discovering to their dismay. They are experiencing unforeseen difficulties in securing an alternator to carry out their deadly work. That the various manufacturers of the necessary electrical machinery have no desire to sell their apparatus for such purposes is evidenced by the fact that no response was received to the invitation for bids for the death-dealing outfit. When electrocutions became lawful in New York State the penal authorities encountered the same difficulties, so that it was only by resorting to considerable strategy that an alternator was secured. It is not unlikely that the Ohio officials will be compelled to seek the same means to attain their end. The objection of manufacturers to selling electrical machinery for the purpose of killing human beings is not one of sentiment alone. It is no recommendation to apparatus of any kind to have it used, even by the constituted authorities, for the purpose of taking human life through its instrumentality.

RECONSTRUCTION OF TROLLEY BASES.

The recent opinion handed down by the United States Circuit Court for the District of Connecticut, modifying Judge Townsend's decision, and thereby permitting of the restoration of trolley bases by those engaged in the repairing and renewing of trolley equipments, is in marked contrast to the decision rendered a year ago by Judge Coxe, sustaining one of the Van Depoele patents. On Dec. 7 last, Judge Townsend, of the United States Circuit Court sitting at New Haven, delivered an opinion sustaining the patent of Van Depoele, covering the fundamental principle of the electric trolley, which patent the court defined as applying to a long, swinging, pivoted, hinged, upwardly spring-pressing arm on top of a car, and having an under-running contact with a overhead conductor. The court at the same time dismissed a bill relating to a second patent of Van Depoele covering a trolley detail, described by the court as applying to a rotating support for the posts upon which the contact arm swings. This latter, the opinion stated, resulted not from a patentable novelty, but from its practical utility in connection with the main invention, which lies in the mechanical adaptation of a well-known device to a novel invention protected by a valid patent. In the present opinion, Judge Shipman also holds that the trolley base is but a feature of the Van Depoele patent, no particular type or form of which is necessary for the successful operation of the trolley. It is upon this fact in conjunction with a previous decision to the effect that if a person legally acquires a title to a patented article he may continue to use it until worn out, or may repair or improve upon it as any other property, that the opinion chiefly rests. The court holds that it is true that a reconstruction of a destroyed or worn-out combination is an infringement, as was evidenced in the case of removing lamp filaments in old bulbs, but it does not follow that because a part or piece of mechanism has become inoperative the original no longer exists, or that it may not be restored to its original use. It is further held by the court that the right to replace an injured part by any person who can supply the same should be conceded by the owners of the patent. The order so modified the opinion handed down by Judge Townsend that permission is given to replace broken stands

or those worn by use, but not to reconstruct or rebuild a combination sold by the patent owners. A loophole is thus provided of which considerable use will be made unless carefully guarded by the owners of the trolley patents.

TELEPHONE DISTURBANCES DUE TO ELECTRIC RAILWAY CURRENTS.

Electrostatic and electromagnetic telephone disturbances due to various causes early led to the adoption of complete metallic circuits together with other more or less effective methods for their elimination. The electric railway has been one if not the principal cause of disturbance, and as a result several legal battles have been waged with decisions generally in favor of the railway interests, it being held by the courts that inasmuch as the streets were intended for transportation purposes, while not intended for telephone poles; that neither party can lay claim to the sole privilege of the earth as a ground return; that such use is an essential feature of successful trolley operation but not for telephonic transmission; that therefore the telephone companies cannot claim the privileges of the earth because of priority and have no lawful claim against railway corporations. As a consequence complete metallic telephone circuits have become almost universal throughout the United States, affording a far better service and fewer troubles with which to contend. Owing to the comparatively few European electric railways it is not surprising that abroad they are just beginning to meet with these difficulties, and as a consequence considerable discussion is being aroused as to the exact nature of telephone disturbances due to electric railway currents. The matter has not been so thoroughly investigated in this country as is being done abroad, and therefore, although an old question, it presents itself in a new light. Perhaps the most interesting series of experiments yet made are those reported by Dr. Behn-Eschenburg in the *Electrotechnische Zeitschrift*, July 16, an abstract of which appears in this issue of The Electrical World. Although the author draws no conclusions from the results, it appears that the telephone disturbances are inherent in the motors, and most likely primarily due to the vibration of the brushes on the commutators. It has hitherto been contended that the electromagnetic effects were due to the variable resistance between the trolley wheel and wire, or between the rails and wheels, but the experiments of Dr. Behn-Eschenburg apparently disprove this explanation.

THERMO-TROPIC CURRENTS.

As early as 1821 Seebeck discovered that if the two junctions of a circuit composed of two different metals be kept at different temperatures, a current is maintained in the circuit. The converse of this was discovered by Peltier. Later it was discovered by Cumming that as the difference in temperature between the hot and cold junctions gradually increases the E. M. F. diminishes, until finally it reverses and the current flows in the opposite direction. Following this Thomson (Lord Kelvin) showed that in addition to the Peltier effect there exist reversible thermal effects, and that an E. M. F. may be produced in a non-uniformly heated homogeneous conducting circuit. In the issue of The Electrical World June 6, and also July 25, attention was called in these columns to the results obtained by Mr. Reed, which demonstrated beyond reasonable doubt that the action of the so-called "Jacques Carbon Battery" was not due to galvanic causes, according to the interpretation which this term has received, and yet it was difficult to explain the high E. M. F. produced on thermo-electric principles. In a communication, which appears elsewhere in this issue, it will be seen that Mr. Reed has adopted a new term for the action which he believes is distinctly different from either that of galvanic or thermo-electric. He finds that if between two similar pieces of metal there exists either an oxide of the metal or any other conducting oxide or salt not decomposed by the flame, upon heating either of the wires while keeping the other cool, a strong electric current flows through the circuit in a particular direction. It was found that the hot copper wire is thermo-electrically negative, whereas with iron wires the hotter is thermo-electrically positive. It was also found that upon transferring the heat from one metal terminal to the other the direction of the current at the same time reversed. The author states that the E. M. F. obtained from two copper wires, with their intermediary junction, was at least one hundred times that which can be obtained from an ordinary thermo-electric couple. It is well to examine the distinctions existing between the phenomena exhibited in this new method which Mr. Reed proposes and those with which we are already familiar. With the exception of a higher E. M. F. than hitherto observed, the facts above noted are in strict accordance with phenomena produced by thermo-electric couples. The oxide or salt between the terminals must be considered as playing the same part as another metal having a different specific heat of electricity and producing in conjunction with the metal a certain thermo-electric power. Inasmuch as the ordinary specific heats of the metal and the oxide are different, it follows that for a certain time at least, a difference of potential will exist between the metal terminals, but that this difference of potential should diminish as the temperatures become equal, which will be at a rate depending upon the length and cross-section of the intermediary oxide. Mr. Reed does not state that any diminution was noticed. If our assumption is true it naturally follows that a reversal of E. M. F. should take place upon applying the flame to the opposite terminal. Inasmuch as the oxide or salt forms but a small part of the circuit, it also seems apparent that a high heat conductivity of the metal in a single element can affect but slightly the electrical properties. It is not so evident, however, that the same is true for a number of elements in series. We believe that Mr. Reed deserves credit not for the new term which he has coined but for having demonstrated the fact that the E. M. F. of a thermo-electric couple can be so materially increased by an exceedingly simple means. We cannot believe that it is in the direction of thermo-electric batteries that the successful solution for converting the energy of carbon into electricity is to be attained.

The World's Coal Product.

The coal product of the world for the past 28 years is the subject of a bulletin prepared by Mr. Edward Parker, of the United States Geological Survey. The figures illustrate the steady advance in the United States in the industrial development. In 1868 and 1869, when the total coal output of the world was about 225,000,000 tons, the United States yielded but 14 per cent. In 1892, 1893 and 1894 the world's output exceeded 500,000,000 tons each year, of which the United States has contributed an average of 30 per cent., having more than doubled her percentage. Great Britain, whose mines furnished more than 50 per cent. of the world's product in 1868, now barely exceeds the percentage of the United States. In 1868 the output of the principal coal producing countries was as follows: United States, 31,648,960 short tons: Great Britain, 115,518,096 tons; Germany, 36,249,233 tons; France, 14,697,236 tons; Austria-Hungary, 7,741,486 tons; Belgium, 13,559,194 tons; other countries, 2,638,491; total, 308,459,053. In 1880 the product was follows: United States, 71,481,569 tons; Great Britain, 164,605,738 tons; Germany, 65,177,634 tons; France, 21,346,124; Austria-Hungary, 16,317,000 tons; Belgium, 18,617,585 tons; Russia, 3,570,413 tons; other countries, 3,621,342 tons; total, 364,737,405. In 1895 the product was as follows: United States, 193,117,530 tons; Great Britain, 212,320,725 tons; Germany, 114,524,186 tons; France, 30, 276,699 tons; Austria-Hungary; 33,570,358 tons; Belgium, 22,507,371 tons; Russia, 8,367,357 tons; product of other countries, 14,250,093 tons; total, 628,805,239 tons.

Death of Sir William R. Grove.

The Right Hon. Sir William Robert Grove died in London August 2. He was born in Swansea, Wales, on July 11, 1811, and educated at Brasenose College, Oxford. Ill health temporarily prevented him pursuing the legal profession when called to the bar at Lincoln's Inn in 1835, when he became interested in electricity. In 1839 he invented the voltaic battery which bears his name and the gas battery. From 1840 to 1847 he was Professor of Experimental Philosophy at the London Institution, and as a member of the council in the last-named year, took part in the reform of the Royal Society's constitution. In his address as president of the British Association at Nottingham, in 1866, his subject was the "Continuity of Natural Phenomena as Evinced by the Progress of Science," his object being to show that the changes in the inorganic world, in the succession of organized beings, and in the progress of human knowledge, result from gradual variations. He was knighted on Feb. 21, 1872, shortly after his elevation to the bench as a Justice of the Common Pleas. He held that office until November, 1875, when through the operation of the Judicature Act, he became a Judge of the High Court of Justice. When he retired, in 1887, he was made a member of the Privy Council. Several important discoveries in electricity and optics were made by Sir William, and in a lecture delivered in 1842, on the "Progress of Physical Science Since the Opening of the London Institution," he first advanced the theory of the mutual convertibility of the various natural forces, and of their all being modes of motion. This theory was further developed in his essay "On the Correlation of Physical Forces," written the following year, which in 1874 reached a sixth edition. It has been translated into French and German and reprinted in this country. He received the medal of the Royal Society in 1847 for his Bakerian lecture on "Voltaic Ignition, and on the Decomposition of Water Into its Constituent Gases by Heat." He was a Fellow of the Royal Society and a member of the academies of Rome and Turin, Knight of the Order of the Rose, Brazil, and other prominent bodies.

The Geneva Exhibition.

A correspondent to the London *Electrician* states that, considering the new and extensive utilization of the water-power of the Rhone, which has been made by the City of Geneva, it was generally supposed that the Exhibition would be a great success from the electrical point of view. The power thus derived and transmitted all over the Exhibition grounds plays a very prominent part, and constitutes in itself one of the most important exhibits. The principal electrical engineering firms of Switzerland have also made very fine displays of their manufactures. One of the most important stands is that occupied by the Cie de l'Industrie Electrique of Geneva. This leading firm is well known in connection with the Thury plant which it manufactures, and which it has installed at Genoa and in a number of other important transmission plants. The exhibits of this firm include a collection of continuous-current dynamos from $\frac{1}{5}$ to 250 horse-power; a 150-ampere generator for series transmission, which drives a number of motors in the Raoul Pictet pavilion; a two-phase synchronous motor, wound to deliver also at will continuous current when working as a rotary transformer; a compound-wound tramway generator, driven by belt together with a number of other generators for supplying power to the crane in the Machinery Hall, to the intramural railway, to the motors driving the pumps for the illuminated fountains, and to other motors in various parts of the Exhibition.

The exhibit of the Oerlikon Maschinenfabrik comprises a number of dynamos and motors. A vertical steam engine made by this firm drives a four-pole continuous-current generator. There is also on exhibition at this stand a portion of a very large field magnet for an immense machine which will be direct-coupled to a slow-speed steam engine. It may not be generally known that this firm makes its own castings, whether of steel or cast iron. Throughout the Exhibition a number of induction motors made by this firm are used for driving various exhibits. Exhibits are also made by the electrical firms of Alioth, of Basle, and the Société Suisse, of Neuhausen. The latter shows a pretty collection of tram-cars. The intramural railway, which is laid in and about the grounds of the Exhibition, works with the current supplied through one rail and returned through the other. The rails are supported on wooden insulating pieces; but these afford only very poor insulation, and in wet weather the leakage amounts to 50 amperes, though the pressure is only 100 volts!

The Thermo-Tropic Battery and a New Method of Developing Electrical Energy.

BY C. J. REED.

The Jacques "carbon-consuming primary battery," as described in THE ELECTRICAL WORLD of March 28 and May 23, 1896, and other journals, did not seem to the writer to be a galvanic cell. A series of experiments with this cell and modifications of it indicated clearly that the E. M. F. was due to thermo-electric, instead of galvanic action. These experiments were repeated at a joint meeting of the chemical and electrical sections of the Franklin Institute on May 26. A detailed account of the results obtained was published in THE ELECTRICAL WORLD of July 25.

Another series of experiments undertaken by the writer simultaneously pointed as strongly to an entirely different conclusion and to the discovery of an entirely new method of transforming heat into electrical energy. Realizing the possible commercial value of this new process, the writer was not prepared to make it public at that time. For this reason no reference, either to the experiments or to the conclusions to which they point, was made in any of the communications heretofore published.

The new process of transforming heat into electrical energy is an exceedingly simple one, and requires for its exhibition only a piece of wire, a galvanometer and a Bunsen burner. A piece of copper wire two feet long and one-eighth of an inch in diameter is well adapted for this purpose. The arrangement is shown in Fig. 1.

The wire is bent into a nearly circular loop and the ends connected to the terminals of a galvanometer or voltmeter, *G*. Two blocks of wood, *W*, held together by screws, form a suitable clamp to hold the ends of the wire firmly in position. After being rigidly clamped the wire is cut or sawed in two at the point, *C*. The ends thus formed are filed smooth and bent, so as to spring together and fit as closely as possible. The ends are then separated and heated to a red heat while exposed to the air. In this manner a thin film of oxide of copper is formed over the ends of the wires. The oxidized ends are then allowed to press together and the flame of a Bunsen burner or blow-pipe is applied to one of the wires, *B*, as close to the junction as possible. The other wire is kept cool. A strong electric current flows through the circuit in a particular direction. If the flame be transferred from *B* to *A*, the direction of the current reverses.

The thin film of cupric oxide may be replaced by a film of any conducting oxide or salt not decomposed by the flame. Fused caustic alkalies serve the purpose well. With the arrangement shown in Fig. 1, using copper wires, an E M. F. of from 0.2 to 0.4 volt may be obtained. With brass, iron and other metals similar results may be obtained. The E. M. F. obtained by two copper wires is at least 100 times as great as could be obtained from a thermo-electric junction composed of any two of the above-named metals. When copper wires or plates are used, the hot wire acts as the zinc plate and the cold wire as the copper plate of the Daniell cell. With iron wires the hot wire acts as the copper plate and the cold wire as the zinc plate of the Daniell cell. It is not necessary that both wires should be of the same metal. Any two pieces of metal may be used, and even carbon and a metal.

The best results are apparently obtained from the best electric conductors, and it seems evident that the development of the electrical potential in this apparatus is due only to the flow of heat across the surface of contact and across the film of metallic oxide or metallic salt intervening between the adjacent pieces of metal. To distinguish this process of transformation from the thermo-electric process, the term *thermo-tropic* suggests itself as a suitable name.

Fig. 2 shows a more efficient form of apparatus. It consists of a strip of sheet copper held in a horizontal plane in the flame of a Bunsen burner and heated to a red heat. Against the upper surface of this sheet is firmly pressed one end of a stout copper wire, the wire and sheet being both connected by suitable wires to a galvanometer. Care must be taken to allow no other heated metallic junctions in the circuit unless they are soldered or welded junctions.

The development of electrical potential by passage of heat from one conductor to another through an intervening electrolyte is a process more nearly resembling galvanic action than thermo-electric. While the efficiency of this method is undoubtedly limited by the second law of thermo-dynamics, it has not the other limitations of the thermo-electric method, and has the advantage of enormously greater E M. F. and of being favored instead of retarded by great heat-conducting power in the metals used.

The very high E. M. F., and the development of electrical potential from a junction of two pieces of the same metal, prove that the transformation is not thermo-electric in the sense in which that term has always been used. The reversibility of direction, the development of electrical potential from two pieces of the same metal and the opposite effects given by copper and iron, all show as conclusively that the electrical energy does not originate in chemical action. There is, therefore, only one inference left, *viz.*, that the transformation results in some way from the flow of heat across the thermo-tropic junction.

It is generally recognized that conducting compounds are conductors only as electrolytes. We should therefore expect the current in this apparatus to have an oxidizing effect on one of the copper wires, and a reducing action on the film of oxide—that is, at one surface there will be oxidation, and at the other reduction in an equal amount. The amount of this oxidation and reduction will be the electrochemical equivalent of the current. This chemical action does not evolve energy and does not produce electric current, but is the result of the electric current passing through the electrolyte. In the experiment with copper wires described above the evidence of this electrolytic action is very marked. That the same electrolytic action takes place in the Jacques battery there can be little doubt, as has been suggested by the writer elsewhere, it having been found in the tests made by Stone and Webster that an amount of carbon was consumed practically equivalent to the current.

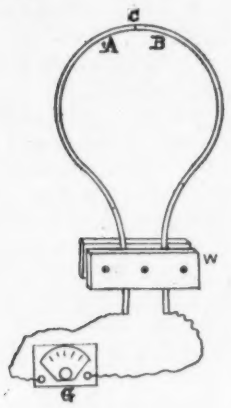


Fig. 1.

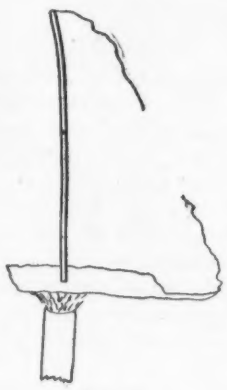


Fig. 2.

In discussing the nature of the action that takes place in galvanic and electrolytic cells, it is to be regretted that there is a careless tendency at the present time to confuse the galvanic cell and the electrolytic cell. The two are very much alike, but also very different. In both there are always two simultaneous chemical reactions, one of which takes place at each terminal of the electrolyte. In all cases these two reactions are each electrochemically equivalent to the current, in both the galvanic and in the electrolytic cell. In either case a metallic substance may pass into the electrolyte or be deposited from the electrolyte, or both may occur simultaneously.

There is one respect, however, in which a galvanic cell always differs from an electrolytic cell. The galvanic cell always evolves energy, and is spontaneous in its action; that is, the sum of its chemical reactions is exothermic. The electrolytic cell always absorbs energy and is never spontaneous; that is, the sum of its chemical reactions is either endothermic or athermal.

If an electric current be passed through a solution of cupric sulphate between copper electrodes, an electrochemical equivalent of copper will be deposited from the electrolyte on the cathode and an equal amount of copper will pass from the anode into solution. The oxidation and reduction of equal amounts of copper cannot either evolve or absorb energy, unless we admit that energy may be either created or destroyed. The quantity of copper oxidized or reduced in this case can only measure the current that has passed through the electrolyte. Energy has been *transferred* from one copper plate to another, but none of it has been evolved from the cell. The only energy transformed in such an action is the amount expended (absorbed from without) in forcing the current through the resisting medium (electrolyte), and is, of course, measured by the product of current and E. M. F. between the copper electrodes. As this reaction is not exothermic, but absorbs energy from without, it is electrolytic and cannot take place spontaneously.

In other words, two chemically pure copper plates, placed in a solution of a copper salt, could not evolve electrical energy or constitute a galvanic cell. Similarly, two zinc plates in a solution of a zinc salt could not constitute a galvanic cell.

If, on the other hand, a copper plate be immersed in copper sulphate and a zinc plate in zinc sulphate, the two solutions being separated by a porous partition through which they may slowly mingle, we have a cell which may be made to either absorb or evolve electrical energy. It may act as an electrolytic or a galvanic cell. If an electric current be passed through the cell, the zinc plate acting as cathode, an electrochemical equivalent of zinc will be added to the zinc plate, and an equal electrochemical equivalent of copper will go into solution from the copper plate. The sum of these reactions is endothermic, and the energy absorbed is equal to the difference between the formation heats of equivalent amounts of copper and zinc sulphates. This amount of electrical energy is transformed into chemical energy, and the action of the cell is electrolytic. The E M. F. required to do this work will be added to that required to force the current through the resisting medium.

If we remove the external source of current and connect the copper and zinc plates by a conductor, these reactions spontaneously reverse. The zinc passes into solution and an equivalent amount of copper is deposited on the copper plate, both being electro-chemically equivalent to the current that flows through the circuit. Here an amount of energy is evolved as electrical energy exactly equal to the difference between the formation heats of the copper and zinc sulphates. The action of the cell is exothermic and spontaneous; that is, galvanic.

In the thermo-tropic junction described above we have two pieces of copper joined by an intervening film of copper oxide acting as an electrolyte. Copper is reduced on one surface. An equal amount of copper is oxidized on the other surface, but no energy is evolved by these reactions, and therefore the transformation is not galvanic.

The same argument applies with the same force to the Jacques battery. Dr. Jacques did not state the direction in which the current flows in his cell. Assuming that the carbon acts as the zinc plate of a Daniell cell, it will be oxidized by an amount equivalent to the current flowing, whether the action is electrolytic or galvanic. The only constituents of the electrolyte (sodic hydrate) that can be reduced are sodium and hydrogen. We may determine the energy of this cell therefore on either of two suppositions, (1) that hydrogen is liberated, (2) that sodium is liberated. But the liberation of an amount of either hydrogen or sodium that would be electrochemically equivalent to the carbon oxidized would require the absorption of much more energy than the combustion of the carbon would evolve. The action of the Jacques cell is therefore highly endothermic and electrolytic, instead of galvanic. The chemical reactions of this form of cell are necessarily very wasteful of energy and are opposed to the electric current. All the energy evolved from the oxidation of the carbon and the additional amount absorbed which is necessary to reduce either the hydrogen or the sodium is wasted, since the reduced hydrogen or sodium on which this work has been expended is all lost.

The possibility of a galvanic or electrolytic cell in which oxidation may take place without equivalent reduction is not worthy of discussion. We might as well expect to find in mechanics a shaft with only one end.

Water-Power Franchise.

Messrs. Edward V. Douglass, of Philadelphia, and Francis H. Clergue, of New York, are seeking a water-power franchise at Sault Ste. Marie, Mich. The proposed ordinance provides for building and operating a canal 15 feet deep and not less than 150 nor more than 600 feet wide through the city, from a point on the shore of St. Mary's River above the St. Mary's Falls ship canal, and the payment by the city of $6000 a year for 20 years for 400 horse-power, including a site to make use of it.

"The Electrical World's" Digest.

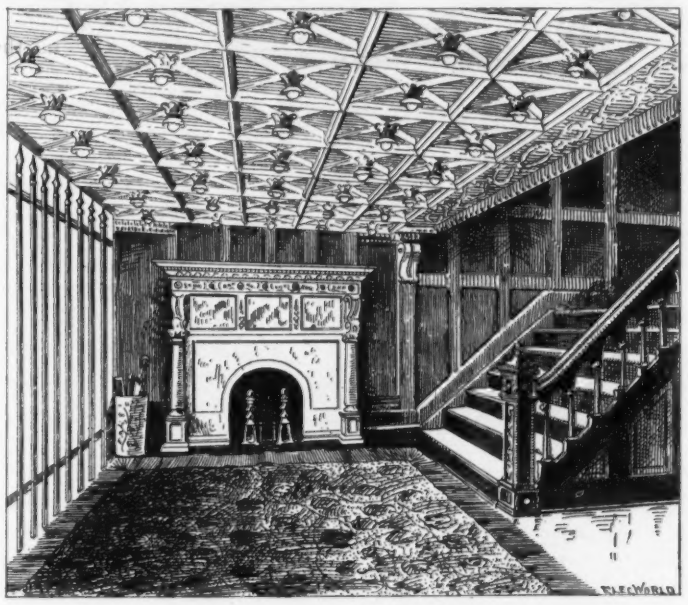
The value of the *Digest* department of The Electrical World, and the high appreciation which it has met with, is evidenced to some degree by the extensive use made of it by some of our foreign contemporaries. We have still to notice an acknowledgment of the source from which such information is obtained. It is interesting to note that articles are not infrequently taken word for word from the *Digest* by some foreign publication, and in due course of time appearing in other American periodicals.

Electricity In Private Houses.

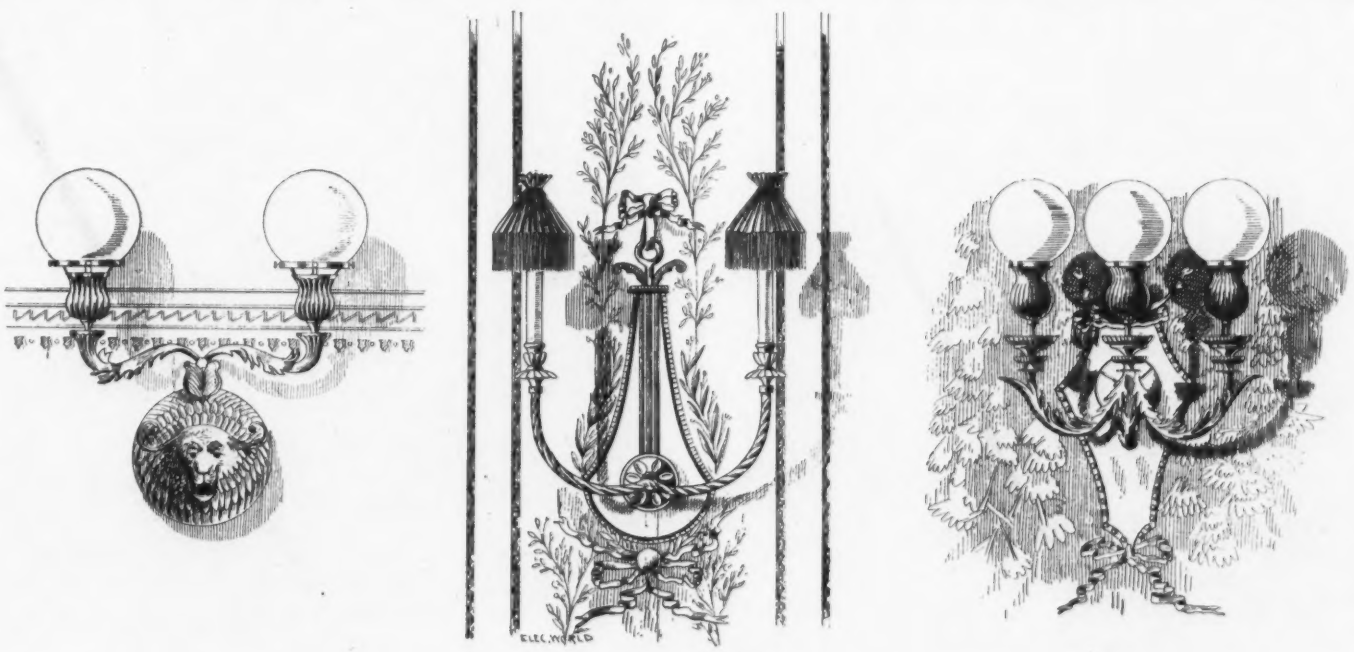
BY THEODORE WATERS.

It is perhaps not generally known that the use of electric elevators in private houses has become so extensive as to warrant their description in a special article. They have not, however, until quite recently existed in sufficient numbers or differed radically from the elevators used in large office buildings and factories to necessitate a separate treatment; but within the last year it may be said their use has reached among the wealthy the proportions of a fad. Rapidly scanning the internal equipment of city dwellings of the leading New York millionaires, we find that not only one, but sometimes three and four electric elevators, form part of the electric service. The "fad" consists, however, only in so far as there seems to be a tidal wave of installations running at the present time, for an electric elevator in a private house is just as logical as an elevator in a public building, particularly as modern practice in city architecture is carrying dwellings more and more skyward. The one great point and requisite—safety in operation and the supposed impossibility of obtaining it without the employment of an attendant—has hitherto been perhaps the chief drawback to the use of private elevators. It is not always possible nor even desirable to have an attendant to operate the car, and an automatic apparatus which would preclude the possibility of accident was thought to be too complicated. But at the moment when the demand became sufficiently great, automatically-operated elevators were made and are now in extensive use.

To fulfill all the conditions required of it for private house service an electric elevator plant must have properties peculiar to itself. It is, first of all, necessary that the car be operated without an attendant; it must be so controlled that even when operated by inexperienced persons it will perform its work automatically and safely; not only must it be capable of being so operated, but its mechanism must be so arranged that the very act of starting the elevator in motion from one part of the house must throw out of control at the same time all other parts, thereby rendering any complication and cross purpose impossible. It would be highly disadvantageous, and perhaps fatal to human life, if more than one person could obtain control of the elevator at one and the same time. The system of control must be so simple that, if such a thing is possible, absolutely no thought be required in operation, even in moments of possible excitement. For instance, in the elevator, which will be described, one push button operates the system as far as the person within the car is concerned, and once that particular button has been pressed all the buttons are thrown out of circuit until the operator has left the car and tightly closed the door behind him. Such a thing as a lever of the kind used in elevators in many office buildings or a cable running the length of the shaft and through the car would be impracticable. The basement apparatus, whether operated as in most cases by the street current, or whether forming part of the generating plant, must be automatic, prompt and noiseless in action, it must occupy a minimum amount of space and must be so protected that careless persons cannot be injured by it. The elevator car should also be lighted. These are cardinal points of virtue for private house electric elevators, the fulfillment of which we shall illustrate by describing probably the most elaborate electric light and elevator plant in the city. Ordinarily a current is obtained from the street for lighting and other electric service, but in this case

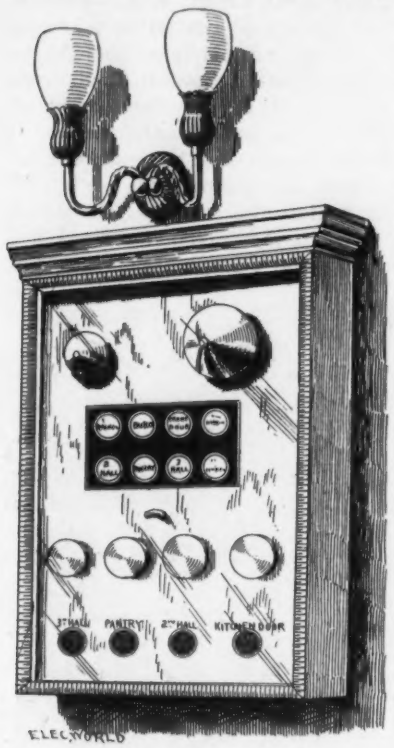


MAIN HALL, SHOWING CEILING LIGHTS.



TYPES OF FIXTURES.

no underground feeders are within a radius of several blocks. This necessitates an isolated generating plant, and one which at the same time is used to supply current to neighboring residences. The plant is also interesting inasmuch as the conditions surrounding it are not different from those which might exist in an isolated country district.

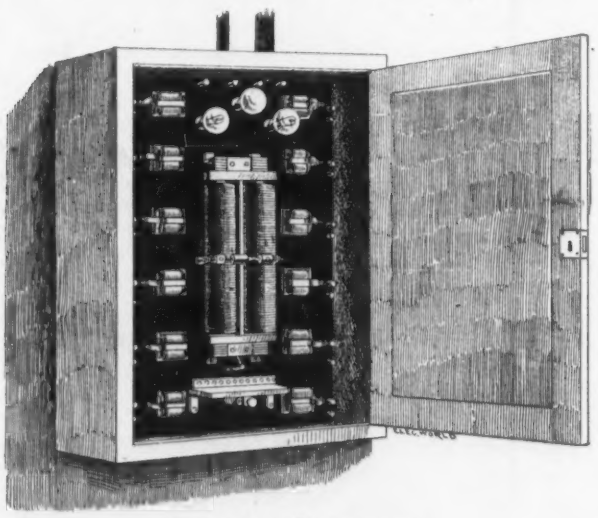


Annunciator.

The elevator was installed by Otis Bros. & Company, and up to a certain point is typical of those operated by a street current.

The car is automatically controlled so that the pressure of a single push-button on each landing is all that is necessary to bring the car to that particular landing. The car having arrived at that landing automatically stops and the door of the shaft immediately unlocks and may then be opened and the car entered. When the door is open the whole system is electrically beyond control, and no part of the machinery can possibly move until the door has been closed. For instance, if some one after using the elevator should carelessly leave the door partly open after him, it would be impossible to call the car to any other floor, it first being necessary to shut that door. This precludes the possibility of an accident happening through a simultaneous attempt of two persons to operate the elevator from different floors. There is but a single push-button on each floor which performs the function of calling the car in either direction, the polarity of the button, so to speak, being changed as the car passes that floor. For instance, as the car passes upward it operates a lever and successively changes the polarity at each floor, so that all the push-buttons above the car can only call it upward and those below can only call it downward.

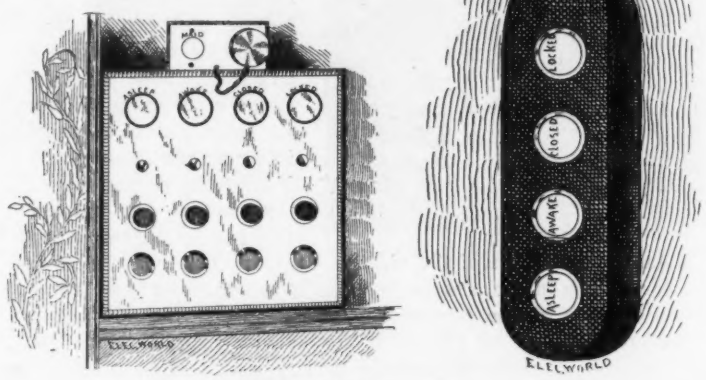
Within the car three buttons are used. These are labeled "up," "down" and "stop." The lights of the car are controlled by touching a button labeled "on" and "off." The car is also connected by a flexible speaking tube with the servants' quarters of the house. As the car always travels at a certain definite slow speed,



Elevator Controller.

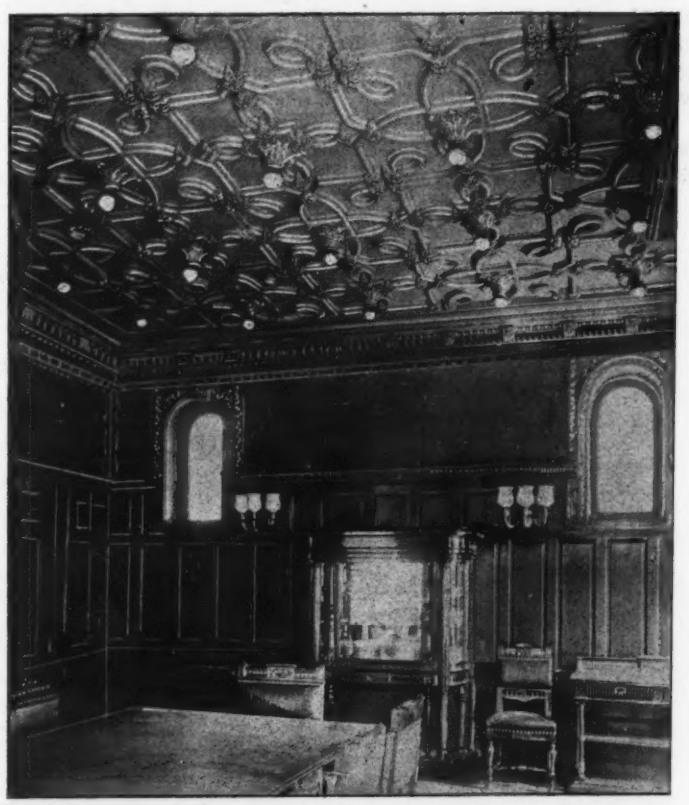
the passengers in going up or down can signal through the tube and summon a servant to the door of the shaft at whatever floor it is desired to stop the car.

This is the mechanism of the car as far as the passenger sees it. It is, however, interesting to view the plant as it exists in the basement of the house. Although apparently requiring a vast amount of complicated machinery, the apparatus which produces the effects detailed above is really comparatively simple. The lifting apparatus is of the regulation Otis pattern and differs but little from the systems of this kind which have been already described. It is to the special system of control operated by push buttons that we must look for novelty. Among the various parts of the apparatus in the basement will be found a switching device which is perhaps the most important part of the whole mechanism. This switching apparatus consists of a commutator in the centre of the box which, by means of a see-saw movement, both starts the machinery and determines whether the car shall go up or down. This commutator is surrounded by a series of electromagnets, 10 in number, and two for each floor. When a button on any floor is touched, the correspond-



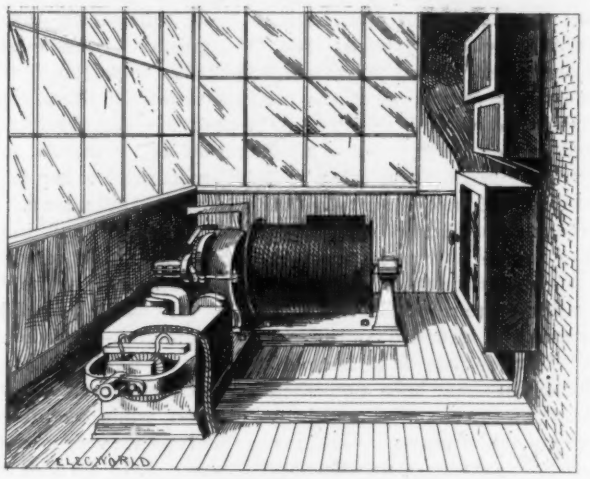
Bed-Room Buttons.

ing magnets operate the central commutator. The latter sets the elevator hoist in motion, and the car immediately starts for the floor where it is wanted. As the switching mechanism is controlled by the position of the car, the latter will, upon a circuit being closed by the touch of the button, allow of a flow of current through either the right or the left magnet corresponding to the floor. The corresponding end of the sea-saw commutator comes down and the machinery started in the proper direction. Every push button about the elevator shaft is connected



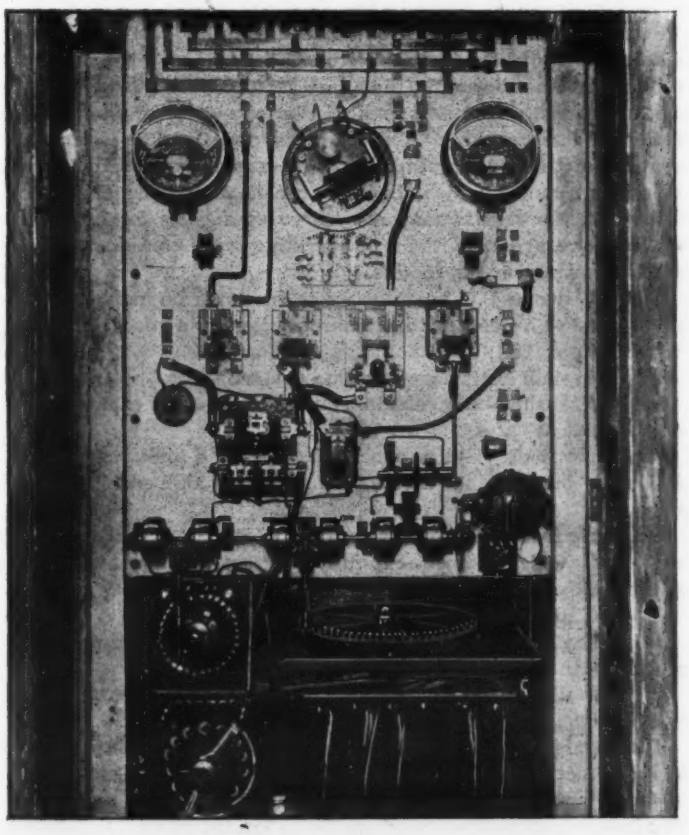
Dining-Room Lights.

with this central commutator and when the latter moves, due to an impulse of a magnet, all these wires on the push buttons are mechanically thrown out of circuit, thus placing the whole responsibility of the system on the push button last pressed. The current controlled by the push buttons flows through a part of the commutator switch common to all. When any one button is pushed this switch is drawn away from its connections, thus throwing out all



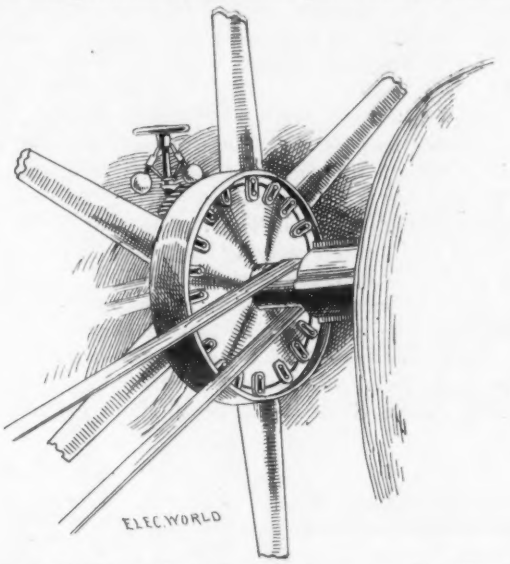
ELEVATOR MACHINE AND MOTOR.

but the one operating through the magnet. The moment the car is stopped at any particular floor and the door has been closed after the passenger has passed out, all of the buttons are thrown into circuit again. All circuits, however, are completed by means of the doors of the shaft, so that if a single door be open no current can possibly pass. The push buttons in the car are operated in practically the same manner as those at the landings except that there is no use for the commutating device, there being one definite button for each direction of motion.



SWITCHBOARD.

The power for this elevator is supplied by a storage battery of 61 cells, having a capacity of 1000 ampere-hours. The battery is daily charged by a Lundell dynamo rated at from 110 to 150 volts and 80 amperes, and is supposed to run at a speed of 200 revolutions per minute. To the dynamo is directly connected a White-Middleton gas engine, built by Messrs. Clemburg & Clemmens. The fly-wheel of the engine terminates in a head piece having a hollow rim. Just within the periphery of the rim is a circle of small steel pins. Each pin is provided with very heavy rubber bands. The shaft of the generator is also provided with a head piece which contains a circu-

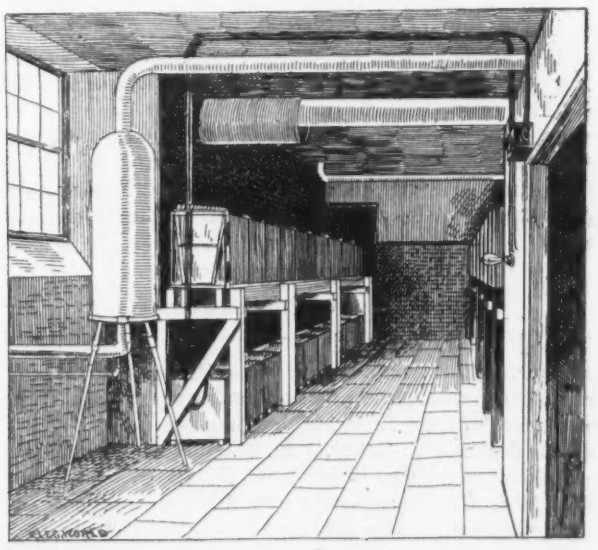


FLEXIBLE COUPLING BETWEEN DYNAMO AND GAS ENGINE.

lar row of steel pins around which the rubber bands are fastened. The engine and dynamo are therefore connected by a coupling which allows of flexibility and at the same time insulates the engine from the dynamo.

The switchboard is provided with Weston ammeters and voltmeters and a voltage regulator. As the charging of the storage battery is superintended each day by a comparatively inexperienced servant, it was necessary to provide for an automatic operation of the plant. The engine is started up by using the dynamo as a motor supplied from the storage battery. When the required speed has been attained the attendant ignites the gas at the engine, which in turn takes the load. As soon as the dynamo has attained a speed sufficient to produce an E. M. F. in excess of that of the battery a magnetically operated switch throws the lighting load onto the dynamo. A small Lundell motor on the switchboard, controlled by the potential regulator, automatically operates a rheostat, which in turn maintains a constant potential at the lamps.

As before mentioned, several mains run through the yards of neighboring residences, supplying them with light. This house is

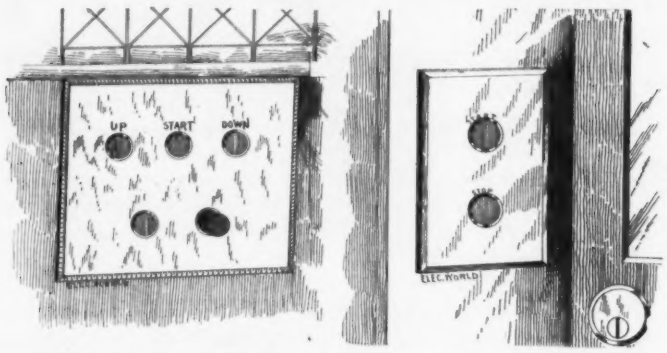


STORAGE BATTERY.

therefore in a certain sense a central station, and it is safe to say that never before was a central station more magnificently appointed.

This house is the finest example of what has been done to reduce domestic electric lighting to an exact science. Entering the front door the visitor finds himself in a spacious hall, the ceiling of which

is embedded with incandescent lamps. A splendid mantel mirror on an onyx mantel-piece doubles the effects of the lights. Directly in front of the door, a wide hardwood staircase leads to what would be total darkness if a magnificent statue holding aloft a cluster of incandescent lamps did not bring out the background with their rays. The dining-room lights are arranged in a similar manner to those in the front hall. In both cases switches enable one to turn on as much or as little light as desired. The various closets in the house are fitted up with lamps, the current for which is automatically turned on and off with the opening and closing of the door. In fact the automatic contrivances are almost without number, and one of the most interesting is that which enables the occupant of the main chamber to close and lock distant doors at will. The main chamber is approached through a long hallway. The door to be closed is at the far end. A flexible cord carrying four buttons hangs down opposite the bed. The buttons are marked "awake," "asleep," "shut" and "locked" respectively. The mistress of the house can press either of the first two buttons to proclaim whether or not the room is accessible to servants, a little indicator outside the door proclaiming the fact. If the button marked "shut" is pressed the door is closed by a weight, and the pressure of the



Elevator Buttons.

remaining button will cause the door to lock. It will also unlock it if pressed again. The entrance to every room in the house is provided with these buttons, enabling a person to light up the rooms before entering them. All the hallways are similarly provided. The regular push button and call bell system is most elaborate, but shows no additional feature of interest than has been described. A table is provided with incandescent lamps, having flexible cords which fit into sockets placed on the floor. Such sockets are also provided in various rooms so that lamps may be moved about from place to place. Some of the lamps consists of statues, others are simply piano or standing lamps, in which an incandescent globe has replaced the oil burner.

Ascending to the roof of the mansion we find that its owner has fitted it up with a roof garden, electrically lighted and adorned with flowers and plants. In the distance the Hudson sweeps onward to the sea and far away the Palisades are in plain view. The plant, inasmuch as it has been in such successful operation for a long time, would seem to settle any question of the proper mode of lighting country residences where current cannot be obtained from local companies.

The Death of Robert Garrett.

Mr. Robert Garrett, ex-president of the Baltimore & Ohio Railroad Company, and the chief promotor of the Baltimore & Ohio Telegraph Company, died at Deer Park, Md., on July 29.

After the death of his father, John W. Garrett, Robert Garrett became president of the vast property of the Baltimore & Ohio Railroad Company, and in connection with the operation and extension of the company's lines he conceived an ambition to build a telegraph system that would successfully rival the Western Union. The Baltimore & Ohio Telegraph Company was the result, and its disastrous failure to accomplish what its creator had designed for it is still fresh in the memory of electrical people. Mr. Garrett's purpose in this undertaking was to wrest the control of the telegraph business from Jay Gould, but his designs were ill-advised. Within five years the telegraph property was turned over to the Western Union Company for about one half of what it cost. Other pet projects of Mr. Garrett ended in a like manner—all because of mismanagement.

Alternating-Current Motors.*

BY DUGALD C. JACKSON.

The development of the greatest possibilities of alternating-current central stations in cities of over 15,000 inhabitants as paying properties requires that a power circuit be operated to give the station a day load; and, while the requirements of the power circuit are fully met by continuous-current distribution at 500 volts, many alternating-current central-station men wish to avoid duplicating apparatus. This natural wish may be satisfied to a greater or less degree by using one of the various polyphase systems in the market, but many of the extravagant claims of the manufacturers of alternating-current apparatus which is designed to be used in a combination lighting and power service must be dismissed as "points for selling" rather than "facts in operating." It is unnecessary to say that only the latter are of interest or value to the central station man.

In the present state of our knowledge, a careful and impartial series of tests of alternating-current motors—the results of which enable a comparison to be made of the performances of the various alternating-current motors with each other and with the well known performance of standard continuous-current motors—is of the utmost value. Various records of the performance of foreign alternating-current motors have been published in electrical periodicals, but the reliability of the record is not always assured, while records of the performance of American machines of this type are very meagre and often bear the stamp of unreliability. Messrs. J. H. Perkins and W. H. Williams therefore undertook, last Winter, to make careful comparative tests of alternating-current motors in my laboratory. This work was carried out in such a way that I can vouch for its accuracy, though it was done while I was virtually confined to my bed with appendicitis. Five-hp alternating-current motors of the following American makers were available for the tests:

Fort Wayne Electric Corporation, single-phase.
Stanley Electric Manufacturing Company, two-phase.
Westinghouse Electric & Manufacturing Company, two-phase.
General Electric Company, three-phase.

A 5-hp three-phase made by the Allegemeine Electricitäts Gesellschaft of Germany was also included in the tests, and results of tests on machines made by the Oerlikon Works and by C. E. L. Brown, of Switzerland, were obtained. A 10-hp Westinghouse two-phaser was also tested. A capacity of five horse-power in the motors to be tested was chosen, as that may be considered to be near the average capacity of motors used in the service of ordinary central stations. The results of the tests may therefore be accepted as representing, for the central stations, comparative results between the average motors which they may use on alternating-current systems, and the results may also serve as a basis for comparison between average conditions of operating with continuous-current and alternating-current motors.

When Silvanus P. Thompson wrote his book on polyphase currents, in 1895, he set forth as the requisites for a good alternating-current motor that:

First: It shall exert a good torque at starting.

Second: It shall be capable of running at a nearly constant speed at all loads.

Third: It shall yield in mechanical power a high percentage of the power put into it (that is, it shall have a high commercial efficiency).

There are three additional requisites which Prof. Thompson overlooked, but which determine to fully as great an extent the success of the motor. These are:

(*a*) The motor shall have a high-power factor.

(*b*) It shall not require an abnormally large current from the lines at the instant of starting.

(*c*) It shall not cause a large unbalancing of the pressures on the lines of a polyphase circuit.

The requisites *a*, *b* and *c* are so important that if they are overlooked a motor cannot give satisfaction to the central-station man, however completely Prof. Thompson's requirements are fulfilled. The last two requisites are especially important where the motors are to be supplied directly from the lighting circuits.

In order to determine how far the alternating-current motors in the market fulfill these essential requirements of a machine which will give satisfaction when operated on the circuits of a central-station plant, Messrs. Perkins and Williams made tests of the following points:

(*a*) Starting torque and current.

* Paper read before the Northwestern Electrical Association.

(*b*) Speed regulation.
(*c*) Commercial efficiency at all loads.
(*d*) Power factor at all loads.
(*e*) Starting current.
(*f*) Effect on the line pressure when starting.

The measurements were made by the following methods:

The power absorbed by the machine was measured by indicating wattmeters, the two-wattmeter method being usually employed.

Currents and apparent watts were obtained from the readings of amperemeters and voltmeters *in each circuit.*

Outputs were measured by a special self-adjusting prony brake which proved to be entirely reliable.

Disturbance of the circuits upon starting the motors was determined by observing the action of incandescent lamps connected to independent transformers and by voltmeter readings of the pressure on the lines.

The torque which the motor could exert when starting ("static torque" of the recapitulation), was measured by clamping the brake up tight and then balancing the pull of the motor. This is by no means the starting torque of the polyphase motors (that is, the torque corresponding to the load which the motor is capable of pulling up to speed), unless the armature-starting resistance is subdivided. In only one of the polyphase motors tested was this the case, and all the others showed a starting torque or the maximum running torque.

The results of the tests are clearly shown in the accompanying table and set of curves, which may be examined at the leisure of the members as published in the electrical papers (as I take it they soon will be), and I at once will advance to the conclusions based on the tests.

Four out of the six motors tested affected the incandescent service disastrously, and showed the absurdity of attempting with them a combined service on the same circuits as the incandescent lighting in those plants where regulation and the satisfaction of the customers are considered of importance. The tests show that the alternating

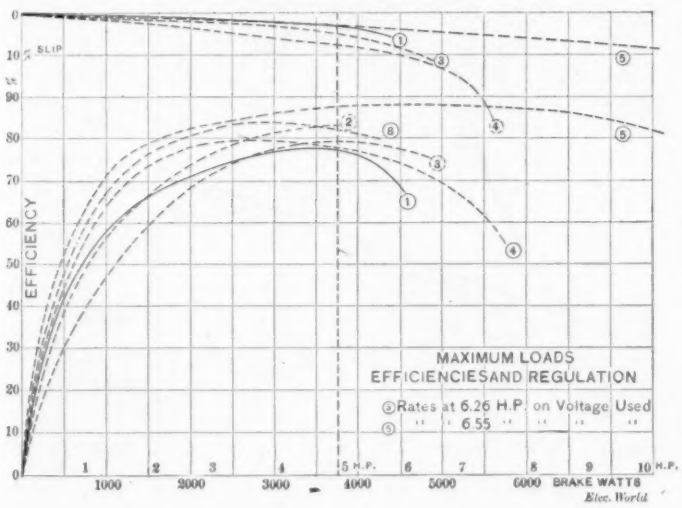


FIG. 1.

hp-hour, net, which is delivered by the motor to the customer's machinery.

Second: On the other hand, the power factor strikes the central station directly; since a low power factor causes an increased current output, with an accompanying increased loss in the lines and transformers, and, even worse, with a demand for an excess capacity and therefore of cost in the generating machinery and transformers.

Supposing that the average load that may be assumed to be carried by a five-hp motor is 3½ horse-power, which is ordinary service, then the average efficiency and power factor of motor No. 3 are 75½ per cent. and 83½ per cent., and of motor No. 5 are 85 per cent. and 59 per cent. In other words, the central station must install over 40 per cent. greater capacity in generators, lines and transformers to supply a given power surface to motor No. 5 than would be necessary if motor No. 3 were used. This difference appears to me to wipe out the difference of 10 per cent. in efficiencies. In other words, the central station owner supplying power to motor No. 3 could probably afford, if necessary, to sell his power at enough lower price per kilowatt to make the customer's horse-power of the same cost as if supplied by motor No. 5, and yet make more money and have better regulation on his plant.

The question of power distribution for alternating-current stations, *as it now stands*, resolves itself into this:

First: If you have a 500-volt continuous-current power service stick to it.

Second: If you can develop a large power service within a radius of two miles from the station, put in a 500-volt continuous-current outfit.

Third: If you can develop a small power service only, which can not afford a duplication of apparatus, or your distances are excessive, then arrange to use alternating-current motors.

Fourth: In this case, arrange to operate all the lamps on one phase to avoid, as far as possible, difficulty in regulation and use such a generator and system of lines as will enable the use of motors.

Fifth: Motors intended for such use should be guaranteed to have

TABLE I. RECAPITULATION.

COMPARATIVE QUALITIES.

Number.	Rated Capacity, H.P.	Rating at Voltage Used, H.P.	Torque, in % of Full Load. Max. Running.	Static.	Starting.	Starting Current, in % of Full Load.	Drop in Speed at Full Load, %.	Efficiencies—%. Max. Eff.	¼ Load.	½ Load.	¾ Load.	Full Load.	Power Factors—%. Max. P. F.	o Load.	¼ Load.	½ Load.	¾ Load.	Full Load.
1	5	5	140	131	77	157	3	77.8	55.2	70.6	77	76.6	76.4	13	37.5	50	62.3	71.5
2	5	5	100	45	44	153		83.8	54.5	72.5	80.5	83.8	67.5	10.5	25.5	58	67.3	64
3	5	6.26	104	90	83	114	9.7	79	52	71.9	78.9	77	84	74	81.6	83.3	83.7	84
4	5	5	186.5	136	39.4	262	7	79.5	62.2	77.2	79.5	77.8	82.6	15.5	44.7	62.5	73.7	80.3
5	5	6.55	171	138.5	86.6	156	3.7	88	75.2	85	87.7	88	78.5	6.8	27.5	45.5	59.8	70.3
6	10	10	<147	142	137	194	4.5	82	67	78.4	81.9	81.1	70	15	40.4	59.1	69.	73.4
7	4.5	4 5	<163	232		357	3.7	79.1	61	73.8	78.4	79.1	88.4	22 2	51.3	69 4	80.3	85.2
8	5	5					4.6	83.8	65 5	80.2	83.8	82	89		52	71.5	81.7	87.2

NOTE.—6, 7 and 8 were not run up to maximum load, on test.

current motors give as equally satisfactory regulation and efficiency as are given by continuous-current motors, but the power factors of most of the machines are small for part load, the starting currents excessive, and the starting torques with the present arrangement of starting resistance are unduly small. The best performance of the American five horse-power machines lies between No. 3 and No. 5 of the tables. These machines will stand well above the others. They are about even in starting torque, but No. 5 will carry considerably the higher load before dropping out of its pace; No. 5 also regulates the better and has the higher efficiency. On the other hand No. 3 has a power factor incomparably better than any of the other machines. Let us see how the question of efficiency and power factor affect the central station.

First: As power is (or at least always should be) sold by metre, the consumer pays for the losses of his motor and it is of interest to the central station that the motors have a high efficiency only in order that a fair price per kw-hour delivered to the customer may not prove to convert into an excessive or even prohibitive price per a high power factor and to start without taking an excessive current from the lines.

Sixth: Never use recording amperemeters with alternating-current motors if you really intend to develop a power service, but use recording wattmeters to indicate the power absorbed by the motors.

Seventh: Where two phase or three-phase motors are used, place two recording wattmeters, properly connected, to indicate the total power by summing their readings. (A single special meter, made up to serve the purpose of the two, may be used, but such an instrument is not now on the market as far as I know.)

This summation is based on the assumption that uniformity of pressure at the lamps is valued by the central-station men.

Carelessness in regard to regulation is one of the features which has militated against the financial success of many alternating-current stations, and its importance should be borne carefully in mind when considering the advisability of a combined light and power service. The lighting is generally the most important service to the station, and nothing should be done to injure its regularity and reliability.

Electric and Magnetic Research at Low Temperatures.

BY J. A. FLEMING.

(*Continued from page 137.*)

We have especially studied the electrical resistance at low temperatures of a large series of steel alloys containing varying proportions of nickel, aluminum, chromium, tungsten and manganese in them. The resistance lines of all the iron alloys are nearly parallel to that of the iron line, only the absolute value of all the ordinates is increased. This is equivalent to saying that the effect of the added material is to increase the specific resistance, but not to alter the slope or form of the resistance curve. Among these steel alloys there are two or three that are very interesting. Nickel steel alloys with large percentages of nickel can, as Dr. Hopkinson has shown, exist over wide limits of temperature in two different physical states, in one of which they are strongly magnetic and in the other they are feebly magnetic, and they pass from the non-magnetic to the feebly magnetic on cooling to low temperatures. Take, for instance, a sample of the 19% nickel steel in the non-magnetic condition. If it is cooled in liquid air we can make it pass instantly into a magnetic condition. In the first state it is fairly ductile and plastic, but in the second state it is very hard and brittle. Moreover, its electrical resistance is permanently altered on undergoing this change. In the non-magnetic state it has a high resistivity of about 81,500 C. G. S. units per cubic centimetre at 0 degrees C., but on cooling in liquid air and becoming magnetic it is found to have decreased to about 47,200 C. G. S. units when taken at 0 degrees C. It is, perhaps, more correct to say that this alloy can exist in an infinity of different physical states, because we have found that the lower it is cooled in temperature the lower its resistivity can be made to be when measured again at ordinary temperatures. On heating up the alloy again to a bright red heat it goes back into the non-magnetic ductile state. Fig. 4 shows how the electrical resistance varies between the limits of — 200 degrees C. and 100 degrees C. when the alloy is taken through a cycle of temperature, beginning at 100 degrees C. in its non-magnetic state.

The 29 per cent. nickel steel exhibits the same characteristics in a less marked degree. A close study of this interesting material shows that there is room for much valuable work upon it yet.

A manganese steel brought to notice by Mr. R. A. Hadfield, having about 12 per cent of manganese in it, is also capable of existing in two states, a magnetic and a practically non-magnetic variety. The magnetic variety, which is much more brittle, is, however, in this case formed by the prolonged slow heating of the non-magnetic variety out of contact with air. In the non-magnetic condition the material has a very high specific resistance at 0 degrees C., about 65,700 C.G.S. units per cubic centimetre, but the magnetic variety has a much lower specific resistance, viz., about 51,400 C.G.S. units at 0 degrees C. In all these cases it is interesting to note that the change of the alloy into the magnetic variety is accompanied by a decrease in resistivity or increase in conductivity, and in an increase in brittleness. We have tried cooling this non-magnetic variety of manganese steel in liquid air, but have not been able in that way to make any change in its condition as regards magnetic susceptibility.

There is a particular alloy, of copper 84 per cent., manganese 12 per cent. and nickel 4 per cent., called manganin, which at ordinary temperature exhibits but little change of resistance with change of temperature. On taking the curve of its resistance over wide ranges of temperature we find that its curve is very concave downwards, and the vertex of the curve lies at about 16 degrees C. Hence, at ordinary temperature small changes of temperature make no change in its resistance, but above this point its temperature coefficient is negative and below it is positive. All alloys in which a negative temperature coefficient has been observed are probably instances of the same mode of variation of resistance. It may be noted in passing that the element manganese, when present in an alloy, seems to have a great tendency to produce high resistivity and small temperature coefficient.

Returning then to the pure metals, we may ask what is the meaning of the fact that in their case the resistance lines all converge so as to indicate that the electrical resistance would vanish at the absolute zero of temperature. We know that the passage, as we call it, of an electric current through a conductor heats it, and that by Joule's law the rate of production of heat in the conductor is proportional to the square of the current strength and to the total resistance of the conductor. Suppose we take two wires, say, of iron and aluminum-copper-nickel alloy of the same size and length. These wires at 100 degrees C. have the same resistance. A unit current flowing through them will therefore generate heat in them both at the same rate. Cool them both down, however, to the temperature of liquid air. In the case of iron the resistance is reduced to one-fifteenth of its value at 100 degrees C.; in the other case it is only reduced by about 12 per cent. Hence at the low temperature the alloy dissipates energy when traversed by the same current nearly 13 times as rapidly as iron. It is a logical deduction from all we know to conclude that if we could reach the absolute zero of temperature the pure metal would not dissipate the energy of the current at all. Imagine two iron wires then stretched through space from the earth to the moon, and kept everywhere at the absolute zero of temperature. We could transmit any amount of electrical energy along them without dissipating any of it as heat in the wires.

As another consequence of this fact any pure metal cooled to the absolute zero of temperature would become a perfect screen for electromagnetic radiation, and would be perfectly impenetrable to electromagnetic induction. We can show this increase in the power of electromagnetic screening by metals when cooled in the following way: A suitable coil of wire is placed between the poles of an alternating-current magnet and a small incandescent lamp connected with the coil. When the magnet is excited it induces currents in the coil and the lamp glows up. A cap of aluminum is made of such a size as to drop easily over the coil. This aluminum is not of sufficient thickness or conductivity to screen off the induction when it is warm. If, however, we cool the aluminum cap in liquid air and then drop it over the coil the lamp for one instant goes out, but it brightens up again as the metal cap instantly warms up. This shows us, however, that if the cap were at the absolute zero of temperature it would, however thin, be a complete screen for the induction. In fact, these experiments furnish us with a new definition of what we mean by the absolute zero of temperature. It is the temperature at which perfectly pure metals cease to have any electrical resistance.

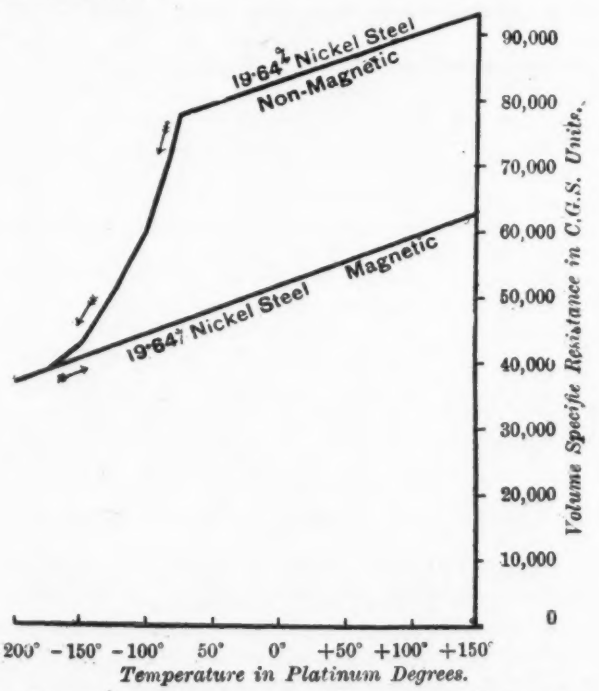


FIG. 4.—MAGNETIC CONDITION AND ELECTRICAL RESISTANCE OF NICKEL-STEEL ALLOY.

In the conduction of currents at ordinary temperature, as we generally know it, two effects are inseparably connected with the conveyance of energy by this process. One is the dissipation of some of the energy as heat in the conductor, the other is loss of potential or fall of electric pressure, and which is one of the factors in the equivalent of the energy so dissipated. If, however, the conductor is at the absolute zero of temperature, there is no dissipation of energy in it, and neither of these consequences would be present. There would be no heat produced in the conductor, and no fall of potential along it either for large or small currents. What, then, under these conditions, is the function of the conductor? The answer is, that it becomes a mere boundary serving to limit the electromagnetic field and determine the direction in which the energy transmission is tak-

[a] See *Proceedings* Royal Society, 1890, Vol. XLVII., p. 138.

ing place. These experiments, therefore, may be regarded as forging one more important link in that chain of experimental evidence which compels us to look for the processes concerned in the conveyance of energy by an electric current, not inside the conductor, as we call it, but in the dielectric or medium outside. We may then ask how is it that different bodies have such various dissipative powers when acting in this way as the boundary of an electromagnetic field. The only suggestion on this point I venture to make here is as follows: Materials of high specific resistance have all probably a very complex molecular structure. The alloys of high resistivity are not, probably, merely solidified mechanical mixtures of metals, but chemical compounds, and even in the case of elementary bodies like carbon and sulphur they may have, owing to their high valency and tendency of their atoms to auto-combination, a complex molecular structure. This structure may bestow upon them the power of taking up energy from the electromagnetic medium, just as gases with a highly complex molecular structure are very absorbent of radiant heat, which, if the electromagnetic theory of light is true, is only another form of electromagnetic energy. All we know at present about the processes at work during the time a conductor is traversed by an electric current is that there is a magnetic field outside the conductor and also within the mass of the conductor, and that some mechanism is at work absorbing energy through the surface of the conductor and dissipating this as heat in the interior. The resistance of a conductor is best defined as, and numerically measured by, the rate at which it dissipates electromagnetic energy per unit of current. For the same current, that is, for the same external magnetic field, conductors dissipate this energy at very different rates. Some, like silver and copper, which have the lowest rates, are elements of low valency and molecular volume, and have probably a simple molecular structure; others, like alloys of high resistivity, have in probability a more complex molecular structure. Both this last, as well as the

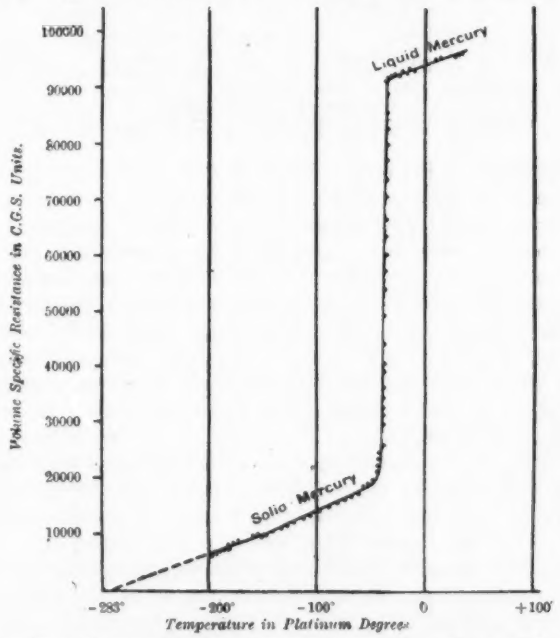


FIG. 5.—RESISTANCE VARIATION OF MERCURY BETWEEN 283° C. AND 5°C.

molecular mobility characteristic of the liquid state, are conditions which bestow the power of taking up rapidly and dissipating the energy of the electromagnetic field, and this has to be kept supplied from energy-transforming sources. We cannot, however, at present construct profitably further mechanical hypotheses to account for this difference in the presence of our great ignorance about ether, molecules and energy.

In passing from the liquid to the solid state there is generally an immense increase in the conducting power of metals. This is well shown in the case of mercury. A glass tube a metre in length was formed into a special coil and filled with pure mercury, suitable connections being provided at the ends. This coil was embedded in a mass of paraffin wax and a platinum wire thermometer placed in contact with it. The whole mass was then reduced to the temperature of liquid air, and observations taken of the resistance of the mercury as it heated slowly up after being removed from the liquid air. The curve in Fig. 5 shows the manner in which the resistance increases with great suddenness between — 41 degrees and — 36 degrees, as the metal passes into the liquid condition. The resistance becomes four times greater between — 50 degrees and — 36 degrees in the course of 14 degrees rise of temperature and while in the act of passing through the melting point of the mercury at — 38.8 degrees C. Fig. 5 shows that the resistance of the mercury in the solid state tends downward, so as to indicate that its resistivity would completely vanish exactly at the absolute zero of temperature. It is interesting to note also that the portion of the resistance curve belonging to mercury in the solid state is sensibly parallel to that portion of it in the liquid state.

We carried on a long struggle with bismuth in the endeavor to unravel some of the electrical peculiarities of that metal at low temperatures. Chemists are aware of the extreme difficulty of preparing bismuth in a state of perfect chemical purity by purely chemical means. From several different sources we procured bismuth which had been carefully prepared by the reduction of the oxychloride, or nitrate, after careful re-precipitations. The bismuth was then pressed into wire and its resistance curves taken down to the lowest attainable temperatures. We found some very extraordinary results. Although sensibly agreeing in resistivity at ordinary temperatures, in two cases the resistance curves had a minimum point, and after reaching this at about —80 degrees tended upwards again, showing that the resistance was increasing as the metal was further cooled. These curves could be repeated as often as necessary with these samples. Another specimen gave a curve with a double bend; see Fig 6.

These results convinced us that it would be necessary to prepare bismuth electrolytically, and with the assistance of Messrs. Hartmann and Braun, of Frankfort, who have made a special study of the preparation of electrolytic bismuth, we were provided with a quantity of the metal which examination showed to be chemically pure. On taking the resistance curve of a sample of the electrolytic bismuth when pressed into uniform wire under great pressure we found that its behavior was perfectly normal, and that the resistance line tended downward, as in the case of all other pure metals, to the absolute zero. Also we found that the specific resistance of this last was very much less than that of the chemically prepared samples, and less even than that employed by Matthiessen. Hence *pure* bismuth is no exception to the law enunciated above.

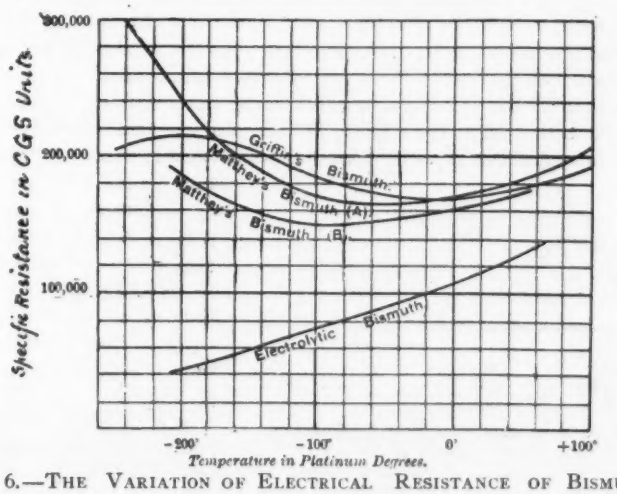


FIG. 6.—THE VARIATION OF ELECTRICAL RESISTANCE OF BISMUTH WITH TEMPERATURE.

Bismuth is characterized especially by many peculiaries. It has been known for some time that the resistance of a bismuth wire is increased when it is placed in a magnetic field so that the lines of the field are perpendicular to the direction of the current flow. This is easily shown by means of one of Hartmann and Braun's spirals, manufactured now purposely for measuring magnetic fields. We have, however, discovered that if bismuth is cooled to the temperature of liquid air the effect of any given magnetic field in changing its resistance is increased many times. Thus, for example, a certain bismuth wire we used had a resistance of 1.690 ohms at 20 degrees C. Placed in a magnetic field of strength 2750 C. G. S. units, its resistance was increased to 1.792 ohms, or by 6 per cent. The wire was then cooled in liquid air and its resistance lowered to 0.572 ohm. On putting it then into the magnetic field of strength, 2750 C. G. S. units, its resistance became 2.68 ohms. Hence it had increased 368 per cent.* This magnetic field can then actually reverse the effect of the cooling and cause the bismuth when cooled and magnetized

* See THE ELECTRICAL WORLD, Vol, XXVIII., July 11, 1896, p 34.

to have a greater resistance than when at ordinary temperatures and unmagnetized.

It will be seen that this process of taking the resistance of a conductor in liquid air is one which affords us a very critical means of discrimination as to the chemical purity of a metal. It ranks almost with the spectroscope as an analytical method.

There is one other method by which we can exhibit the change of conductivity in a metal when cooled, and that is by the increased deflection which a disc of the metal experiences when suspended in an alternating-current field in such a position that the plane of the disc is at an angle of 45 degrees to the lines of the field.

Time will only permit one brief reference to the behavior of carbon in regard to electrical conductivity when cooled to low temperatures. We have found that carbon in the form of carbon filaments taken from various incandescent lamps, continued to increase in resistance as it was lowered in temperature. The resistivity at various temperatures of the carbon from an Edison-Swan lamp at various temperatures are as follows:

C. G. S. Units.		Temp.	C. G. S. Units.		Temp.
3835×10^3	at	99 degrees C.	4054×10^3	at	— 78 degrees C.
3911×10^3	at	18 degrees C.	4079×10^3	at	— 100 degrees C.
3953×10^3	at	1 degree C.	4180×10^3	at	— 182 degrees C.

These values when represented on a chart give almost a straight line and show that the resistivity of carbon continually increases as it is cooled, but at a very slow rate. Its temperature coefficient is therefore negative, and of about the same absolute magnitude as many alloys of high resistivity. The resistivity of this form of carbon is about 3000 times that of silver.

Adamantine carbon taken from a Woodhouse and Rawson lamp had a resistivity 50 per cent. greater. All the so-called insulators—*e. g.*, glass, gutta-percha, ebonite, paraffin—have resistivities enormously greater than that of carbon ; but, like it, their resistance increases as the temperature is lowered.

We must now pass on to consider some problems in thermo-electricity which have engaged our attention. If we construct a thermo-electric couple of two metals and connect this with a galvanometer, and if one junction is kept at a constant temperature, say o degrees C., while the other junction is heated or cooled to various temperatures, we shall in general, but not always, find an E. M. F. acting in this circuit when the junctions are at different temperatures. This E. M. F. depends on three things—the nature of the metals, the temperatures of the junctions, and on a certain temperature called the neutral temperature of the metals. An important matter in the experimental study of thermo-electric action is to discover the position of these neutral temperatures, when different metals are tested with lead as the standard of comparison, and when one junction is kept at o degrees C. Elaborate experiments made by Prof. Tait many years ago furnished full information on this matter for temperatures lying above o degrees C., and we especially desired to extend this knowledge to ranges of temperature between o degrees C. and — 200 degrees C. Accordingly, a number of thermo-electric junctions were prepared of various pure metals and alloys, the comparison metal being always pure lead. These couples were grouped together and one set of junctions always kept at o degrees C. in melting ice. The other sets were cooled to various low temperatures by means of liquid air. The experimental process then consisted in measuring the E. M. F. set up in each couple respectively and at the same instant measuring the temperature of the low-temperature junction. After various failures, a device was adopted for making this double measurement with great accuracy and expedition.

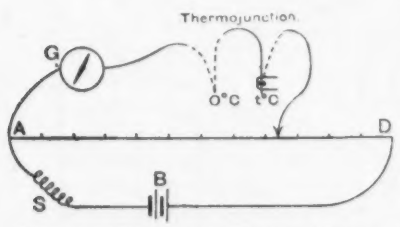


Fig. 7.—Combined Potentiometer and Resistance Balance.

The arrangement consisted of a combined potentiometer and resistance balance (Fig. 7). Omitting details, it may be stated that I succeeded in devising an arrangement of circuits in which the change from a potentiometer to a resistance bridge was effected by moving two brass plugs from one pair of holes to another. This instrument formed a combined resistance and E. M. F. measurer which enabled us to do two things. First, to measure the E. M. F. in any thermo-couple; secondly, to measure the temperature of the low-temperature junction by measuring the resistance of a platinum wire wound round that junction and acting as a thermometer. In actual practice the platinum thermometer consisted of a small, hollow, copper cylinder. In the interior of this cylinder were inserted a number of the thermo-junctions, and round the outside was wound the platinum thermometer wire. Aided by this device we were able to measure temperatures with an accuracy of one twenty-fifth of a degree at a temperature of — 200 degrees C., and to ascertain at the same instant the exact action in the couple. When these arrangements had been perfected the method adopted was to put one set of the junctions into melting ice. The other set enclosed in the copper cylinder were embedded in a mass of paraffin wax, which was then cooled down to the temperature of liquid air. The mass was then removed and inserted in a vacuum vessel and allowed to heat up very slowly. At frequent intervals during the heating the E. M. F. of the couple was taken, and also the temperature of the junction.[1] The events which, under such conditions, happen in the case of a platinum-lead junction, can easily be shown and are very interesting (Fig. 8).

At the first immersion of one junction in liquid air, while the other is in melting ice, we get a current, as shown by the galvanometer, in one direction. On lifting the junction out of the liquid air it begins to warm up. The first effect of this heating is to reduce the thermo-current in the circuit, at about — 111 degrees on our platinum scale, some distance therefore above that of liquid air the current in this circuit falls to zero. As the junction continues to heat up, the current increases again in the opposite direction. At about — 60 degrees the low-temperature junction reaches the temperature called the neutral temperature, and the current is a maximum in one direction. It then begins to fall off once more, and it finally becomes zero again when the two junctions are both at the temperature of melting ice, and it lastly increases in the opposite direction as this variable junction continues to warm up from o degrees C. to higher temperatures. Having carried out the observations described with all our thermo-couples, the results were represented in a chart as follows: A horizontal line was taken on which were marked off divisions representing platinum temperatures. Vertical ordinates were then drawn at various temperatures for each couple representing the E. M. F. in the couple when the cold junction was at the temperature denoted by the abscissa of that ordinate. In this way a series of curves were delineated which all passed through the point representing o degrees C. These curves are the curves of thermo-E. M. F.

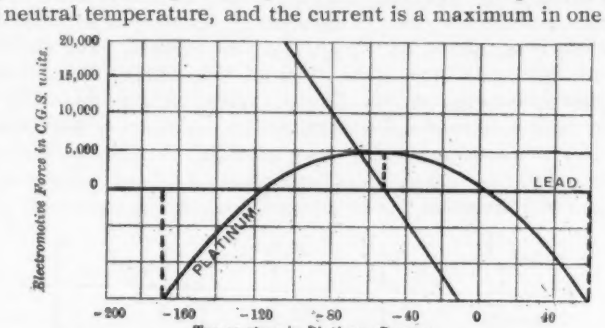


Fig. 8.—Thermo-Electric Power of Platinum—Lead Couple.

In Prof. Tait's researches on this subject he adopted a method of representing the facts which has many advantages. Suppose the couple to have one junction at a constant temperature, and the other to be varying. At any instant the E. M. F. of the couple is varying at a certain rate with the changing temperature of the non-constant junction. This rate measures what is called the thermo-electric power of the metals with respect to each other at that temperature. If we measure the slope of the E. M. F. curve at any point, it can easily be shown that the numerical value of this slope gives us the rate of change of E. M. F. with temperature. If we plot these slopes in terms of the corresponding temperature we obtain another set of curves called curves of thermo-electric power. Lead is always taken as the standard metal for comparison, because the Thomson effect on lead is zero. From our chart of thermo-electromotive forces we have constructed another one of thermo-electric powers. The lines of thermo-electric power cut the lead line in various places and the temperature at which they do this is called the neutral temperature of that metal with respect to lead. Prof. Tait deduced from his experiments that these thermo-electric lines were straight lines for temperatures above zero C., and he made, in addition, the important discovery that for certain metals, such as iron and nickel, the thermo-electric lines have sudden changes of direction at high temperatures.

(*To be continued.*)

[1] For fuller information see Dewar and Fleming on the "Thermo-Electric Powers of Metals and Alloys," *Philosophical Magazine*, July, 1895.

THE ELECTRIC RAILWAY

On the Measurement of the Insulation Resistance of Street Railway Cables.

BY EDWIN J. HOUSTON, PH. D., AND A. E. KENNELLY, SC. D.

In the street railway systems of large cities it has become necessary to place a number of feeder cables underground. A large amount of capital is necessarily expended in these cables, and their insulation is a matter of considerable importance. It is well-known that when such cables are tested at the power-house from which they diverge, considerable difficulty is experienced in obtaining reliable observations with the ordinary deflection method of measuring insulation employing a battery and galvanometer. Superposed upon the leakage current passing through the galvanometer in such measurements are a series of erratic current oscillations or variations. These may be due either to induction from neighboring cables or to the absence of what may be regarded as perfect ground connection. Thus, in Fig. 1 the generator D represents the working dynamo or dynamos in the power-house supplying the working cable or cables C'; the testing battery E, is grounded at G, either directly to the station ground or to some ground in its vicinity. There is necessarily some small resistance in the ground connection of the station and the varying load current passing through this resistance establishes a varying small C. E. M. F. or drop of pressure at ground connection p; the result is that the E. M. F., E, of the testing battery, is virtually varied in conformity with variations of load on the system, and these variations produce disturbances upon the testing galvanometer g. In some cases these disturbances may be so violent that no reliable test can be obtained while the power house is working. The following method, which is based upon the method of fall of charge, appears to supply a reliable means for determining the insulation of cables under such circumstances.

In Fig. 2, C represents the cable whose insulation is to be measured. c, is a small condenser, K, is a back-and-front contact-testing key, k, a front-contact key, E, a testing battery of say 100 silver chloride cells, and g, a d'Arsonval galvanometer.

The method of operation is as follows:

The cable to be tested after being insulated at the distant end is grounded at the power-house for a sufficient length of time to discharge it as thoroughly as possible, so as to get rid of the effects of the charge from the working 500-volt pressure. It is then connected by the key K with the condenser c, which is in its turn grounded through the galvanometer g. The battery key k, is then depressed, charging both condenser and cable. The key K, is then released, and the discharge passed through the galvanometer g. This gives a deflection representing the full charge of the cable. Since the galvanometer is in permanent connection with the cable through the condenser, a moment may be selected for the

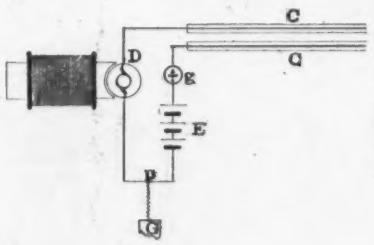


FIG. 1.

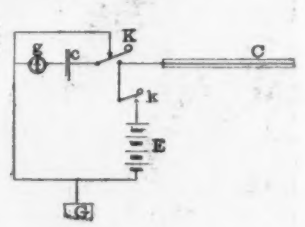


FIG. 2.

release of the key k, when the current through the galvanometer is zero, indicating a moment when the charge in the cable is steady. The key K, is then again depressed and the battery key k, again charges the system, say for 30 seconds. The battery key is then released and the system is allowed to leak for, say five minutes. At the end of that time, or at any suitable moment, shown by the galvanometer g, the key K, is lifted from its front contact and discharged through the back contact and through the galvanometer. This deflection will be less than the first deflection by reason of the loss of charge or leakage through the system. The advantage of this method over the ordinary fall of charge method lies in the fact that if the moment for disconnecting the small condenser from the cable be suitably chosen, the charge in the condenser represents the normal charge in the cable at that moment, and the discharge subsequently made through the galvanometer is not liable to any irregularities either from induction or imperfect ground.

In order to determine in megohms the insulation from these observations it is necessary to know the electrostatic capacity of the cable in microfarads. This can be determined by any of the well-known methods, or it may be obtained in the first instance from the manufacturers when the cable is delivered. It is not, however, essential that the capacity should be known in order to ascertain whether the insulation of the cable is in good condition, since the percentage of loss of charge in a given time, such as five minutes, is a definite criterion of the cable's insulation, and it would be sufficient to record this percentage from month to month without actually computing the insulation except when specially necessary. The loss of charge for a given cable does not depend upon its length, if the insulation be uniform, mechanically and electrically. A five-mile cable of the same material and dimensions will lose a given percentage of its charge by uniform leakage in the same time as a one-mile cable.

The well-known formula for the insulation resistance by loss of charge is:

$$R = \frac{0.4343\, t}{C \log \frac{Q}{q}} \text{ megohms,}$$

where R, is the absolute insulation resistance of the cable in megohms, t, the time of insulation or leakage in seconds; C, the electrostatic capacity of the cable in microfarads, and $\frac{Q}{q}$ the ratio of full charge to reduced charge. Since in this case a small condenser is added to the cable, the result has to be corrected, strictly speaking, for both the capacity and the leakage in this condenser. It is, however, preferable to employ a very small condenser, say $\frac{1}{10}$th microfarad. This with a testing E. M. F. of 100 volts should be sufficient to give a good deflection on the galvanometer scale without any shunt. This possesses the advantage of obviating any error due to the use of a shunt with momentary discharges through the galvanometer, and also renders the correction for the capacity of the condenser in most cases negligibly small.

The following example of an actual measurement made in this way will serve to illustrate the method.

A cable three miles long has an assumed capacity of three microfarads. E = 100 volts, approximately. c = 0.025 microfarad. The full discharge was 211 divisions deflection, and the discharge, after a delay of 300 seconds, was 197 divisions. The insulation resistance was therefore

$$R = \frac{0.4343 \times 300}{3 \times \log \frac{211}{197}} = \frac{0.4343 \times 300}{3 \times 0.15697} = 276.7 \text{ megohms}$$
$$= 830.1 \text{ megohm-miles.}$$

For all ordinary purposes it would be sufficient to observe that the percentage of loss of charge in five minutes was

$$\frac{64}{211} \times 100 = 30.33 \text{ per cent.,}$$

and this, without any calculation, would serve as a reliable criterion of the cable's insulation, practically independent of all disturbances from induction or imperfect ground.

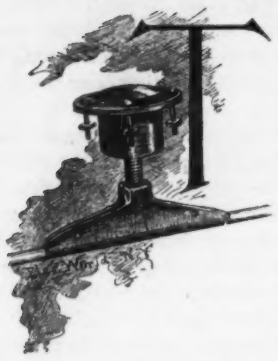
Wrought Iron and Steel.

In a talk before the Franklin Institute, Mr. W. F. Durfee defined wrought iron to be not a metal but "a mechanical mixture which, at its best, consists of clusters of crystals of practically pure iron, separated from one another, as the result of the manipulative processes employed, by films or threads of an unavoidable impurity, called 'cinder.'"

Crystals of iron were defined as being "minute ultimate structural units of that metal, bounded by well defined planes, whose intersections always form salient angles. A number of such crystals may cohere and form an aggregation, having bounding planes similar in outline and relative arrangement to those of any single crystal."

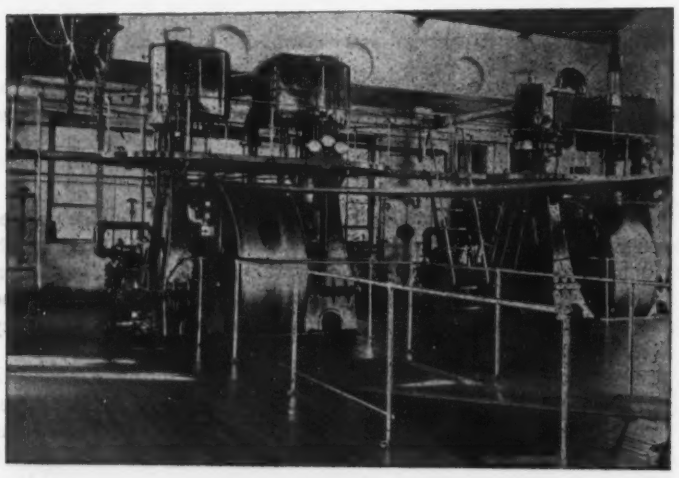
Steel is iron freed from mechanically-mixed impurities, as cinder, by a melting process, during which there is combined with it chemically a small percentage of other impurities, introduced for the purpose of modifying its strength, hardness, elasticity or ductility, in such a way and degree as to adapt it to the particular use to which it is to be applied.

The Syracuse Street Railway.



THE Syracuse Street Railway Company has recently erected a new power-house located on the west side of the Erie Canal, in which a new equipment has been introduced. The steam plant consists of five horizontal multi-tubular boilers of equal size. They are 15 feet long and 90 inches in diameter. Buckwheat anthracite coal is used which is delivered in cars switched from the New York Central & Hudson River Railroad directly into the boiler-room, enabling an entire carload to be dumped in front of the furnaces. The coal is fired to the boilers in a thin spread fire. The grates are five feet from door to bridge wall, and are 26 inches below the boiler shell, a low combustion chamber being necessary for the use of anthracite coal. The boilers are set with half fronts in the ordinary type of brick setting. The coal consumption averages 18 tons per day. The grate is of the hand-shaking type, and the ashes are wheeled out of the boiler-room, no special conveyor being used. No trouble has been experienced, due to scale arising from the use of the city feed water. Two Worthington duplex feed pumps supply the boilers. The fuel gases are delivered to a stack 168 feet high and with an internal diameter of 7 feet 6 inches. The stack is lined with firebrick, and around this lining is a 6-inch air space. Within the stack is an economizer designed and installed by Mr. N. B. Kellogg, chief engineer. It consists of fifty 1½-inch pipes.

The steam is generated at a pressure of 110 pounds, and passing through a magnesia-covered steam piping system enters the engines directly, no separator being used. The steam is nevertheless practically dry. The compound engines, built by the Cleveland Ship-Building Company, are of the marine type, the high-pressure cylinder being provided with an automatic governor. The cylinder dimensions are 16½ inches high pressure and 31 inches low pressure, the stroke being 24 inches. The high-pressure cylinders are fitted with piston valves and the low-pressure cylinders are fitted with valves of the flat gridiron type. Three of these engines are employed and the fly-wheels are in between the cylinders of each. They are 9 feet in diameter, have a 36-inch face, and run at a speed of 142 revolutions per minute. The engines exhaust into a surface condenser, the condensing water being then pumped back into the boiler. The circulating water is taken from the canal and returned there. No provision has been made for exhausting into the air, and up to the present no necessity for doing so has arisen. The air-pumps are of the Worthington make, each engine having its own pump and condenser. A vacuum of from 23 to 26 inches of water is maintained. The engines are mounted on a brick pier, the foundation of which is of cement and rubble. Light-feed oil cocks are used. Each engine is directly belted to a four-pole 300-kw G. E.



Engine Room.

generator rated to run at 400 revolutions per minute. The generators are, however, run at 360 revolutions, at which speed they generate 550 volts. There is no rheostat to spare, and it is probable that an increase of speed would be beneficial. The generators are of the familiar G.-E. four-pole type and have drum armatuers with spiral end connections. The driving pulleys are each 42 inches in diameter. The equalizer switch is on the post which will be seen near the generator. The output and equalizer wires pass through holes in the floor bushed with massive porcelain insulators. Fig. 5 also affords a view of the switchboard, which is arranged immediately behind one of the generators. It is of the ordinary panel type, having three generator panels and three circuit panels. Each of the former is provided with a single-pole switch, and a T.-H. ammeter, rheostatic control and a circuit-breaker. The circuit-breaker is connected to an automatic alarm, and when all the circuit-breakers come out the alarm bell rings. The breakers are set for 900 amperes, although the heaviest load on any machine is 600. The panels are provided with the customary field switches, ground-detectors and other accessories, the instruments being illuminated by an incandescent lamp. A single Weston voltmeter on a swinging bracket serves for all three generators, as appropriate voltmeter-switches are provided at each panel. The voltmeter is of the illuminated dial type.

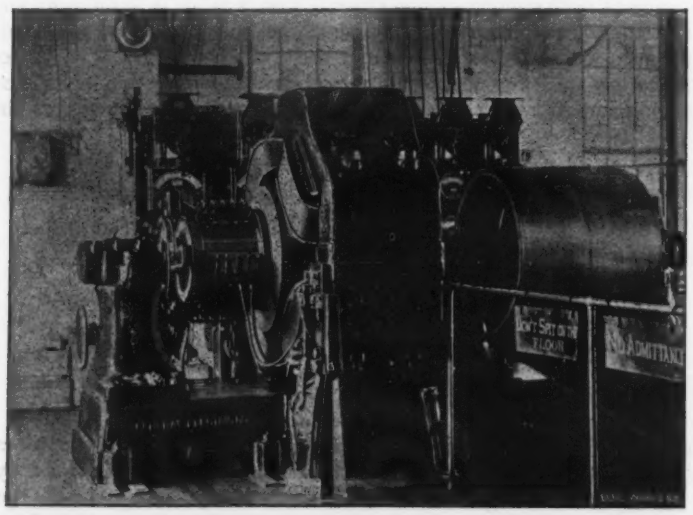
Each of the three circuit panels carries two feeders, making six in all. Each circuit is controlled by a single-pole switch. There are, however, but three circuit-breakers for the six feeders. The feeders vary in size from No. 000 to No. 0000 B. & S. gauge. No. 00 trolley wire is used.

The machinery is installed in really two pitch roof buildings 55

Boiler Room.

feet wide set side by side and having iron girder roofs and brick inwalls. One contains the boilers and the other the engines and dynamos. The latter is swept by a rolling crane of 55 feet span.

The overhead construction is suspended from both steel and wooden poles, the latter being used on the suburban sections. Double track is used throughout the road with Johnston and Wharton girder rails. The rails are bonded with ½-inch bond 42 inches long, two bonds being used for each joint. The bonds were made by the company's employees. There are seven negative return feeders. No trouble due to electrolysis has been experienced.



Type of Generator.

The total rolling stock consists of 79 cars, 49 of which are motor cars and 30 trailers, built by the Brill, Jones and Stephenson Companies. The two former types are mostly provided with cross seats with an aisle at the side and entrances at the side and rear, the rear doors being set toward the step.

The Stephenson cars are provided with electric conductor signals

and are mounted on Brill and Peckham trucks. Thirty-one motor cars and nine trailers are operated at the same time over a road 28½ miles long. W. P. 30's and 50's and G. E.-800's constitute the motor equipment.

This company is now supplying power to the Syracuse Consolidated Street Railway Company, which corporation, it is rumored, the Syracuse Street Railway Company will soon absorb. The combination should prove an extensive, well-managed and money-making enterprise.

Niagara Power in Buffalo.

A contract was closed, on July 27, between the Cataract Construction Company, of Buffalo and Niagara Falls, the Buffalo Power & Conduit Company, the Buffalo Street Railway Company and the General Electric Company, involving the transmission to Buffalo of electric current generated at the Falls. The power, according to the terms of the contract, will be delivered in Buffalo not later than Nov. 4 next.

The Buffalo Power & Conduit Company, which was incorporated last June, will control the distribution of the current in the city, and will connect its lines with the transmission line of the Cataract Construction Company, at the northern boundary of the city.

The contracts for the construction of the transmission line, which is to bring the current to the city limit, it is stated, were let on July 25. The pole line will be of sufficient capacity to carry wires for the transmission of 40,000 horse-power to the city, should that amount of power ever be demanded. The line will run from the transformer house at Niagara Falls along what is known as the two-mile-line road, near the tracks of the New York Central and Erie Railroads, crossing the creek at Division Street, and from Tonawanda to the Buffalo city line it will follow the banks of the canal.

The General Electric Company will furnish the generating apparatus required to deliver 1000 horse-power in Buffalo. This power will be delivered to the Buffalo Street Railway Company by Nov. 4 next, for the operation of its cars.

It is not the intention of the Buffalo Street Railway Company, however, to abandon its Niagara Street power plant, at least for the present, although this object may be ultimately carried out.

In this connection it is stated that the Buffalo Street Railway Company produces the steam-power which it is now using to run its machinery for the development of electrical power, at a remarkably low cost, and the adoption even partially of Niagara Falls power in the face of this fact indicates the belief of the company in the successful and cheap transmission of this power to the city. The steam-power of the Buffalo Street Railway Company is one of the very cheapest developed powers in the country.

It is stated that the company will utilize the new power entirely for night-car service, and in conjunction with the Niagara Street plant during the daytime.

The electrical equipment at the Falls will be on the three-phase system, the initial voltage (two-phase) being 2200. This will be raised to 10,000 or 20,000 (three-phase) (the limit has not yet been settled upon) by means of three step-up transformers. Any two of the transformers will deliver 2500 horse-power, the third being a spare one. It is the intention of the Cataract Construction Company to commence transmission operations at 11,000 volts, and later to increase the capacity of their transmission system by increasing the potential to 22,000 volts. The transformers will be designed and insulated to withstand the latter pressure. A complete system of air-blast apparatus is also to be provided for cooling these transformers, as well as a marble switchboard with all necessary instruments for controlling their operation. At the Buffalo end of the line the voltage will be reduced to 400, and at this pressure the current will drive two 500-hp compound-wound rotary converters at the Niagara Street power-house. These converters will produce a 550-volt direct current for the operation of the cars. The rotary transformers will be placed in parallel with the present generators in the Buffalo power-house. They will be of the iron-clad type with steel frames, with collector-rings for the three-phase current at one end, and a commutator for the direct current at the other. They will have air poles and will run at 500 revolutions per minute, and are similar to that placed in the Niagara power-house to furnish current to the Buffalo & Niagara Falls Railroad.

One of the General Electric Company's engineers is reported to have said that 88 per cent. of the power generated at Niagara Falls will be delivered to the trolley lines in Buffalo, representing losses in transmission, etc., of 12 per cent.

This is the first contract made covering the actual transmission of power to Buffalo from Niagara Falls. For it there was keen competition between the General Electric and the Westinghouse Companies, and the capture of the coveted prize by the General Electric Company may occasion some surprise, especially in connection with the recent visit to the Falls of Messrs. Westinghouse, Tesla and others interested in Westinghouse affairs.

The Surface Transportation Problem in New York.

It would seem from an interview with Mr. Vreeland, president of the Metropolitan Traction Company, as reported in the New York *Herald* a few days ago, that the Board of Directors is not a unit on the subject of motive power on its lines. The decision to discontinue the underground trolley system on Lenox Avenue and 116th Street seems to be in the nature of a compromise between the contending factions in the board. The proposition to try the compressed air system of propulsion met with strong opposition from the advocates of the electric system, but under the existing armistice it is about to be tested. It has been decided by the Board of Directors that in no event will the cable system be extended, and that if the compressed air system did not prove satisfactory efforts would be made to find some other cheap and adequate method of propulsion, so that horses might be done away with entirely on the company's lines. Mr. Vreeland is reported to have said that the underground trolley system is unsatisfactory where there is a large amount of traffic. The main objection he offers in support of this statement is that the locating of breaks is an operation that requires an indefinite amount of time—from four hours to two days—and then it usually takes only a few minutes to effect repairs.

There will be no extension of the underground trolley, Mr. Vreeland says: "Its operation is not certain enough."

Mr. Vreeland thinks that the accusations which New Yorkers are continually making against the railway companies, that this city is years behind every other city of any size in the world in transportation, is rather unfair to the companies. The one electric system which has been found entirely satisfactory is the overhead trolley. Every other city in the world uses it. Yet the company is expected to provide as good and as rapid transportation when it is restricted from the use of the one method which has been thoroughly tested and has not been found wanting. In default of known methods of transportation which his company is forbidden to use, it is trying to find something else that shall be satisfactory.

How Not to Correct an Abuse.

It is stated that the management of the Staten Island Electric Railway has warned the conductors on its lines that unless the practice of stealing fares discontinues measures will be taken to prosecute the thieves. It is not likely that a threat of this kind will have any continued material effect. If the company is aware of the fact that it is being robbed by its employees, more effective measures should be adopted than this mere admonition. The protest will avail little, but on the contrary the dishonest conductors will continue their pilfering and prosecute the more guardedly their dishonest work.

The Rapid Transit Act Declared Constitutional.

On July 29 the Appellate Division of the Supreme Court rendered a decision affirming the judgment of the court below dismissing the complaint in an action against the Mayor, etc., of New York City, and sustaining the constitutionality of the Rapid Transit Act authorizing the building of the routes laid out by the Commission on the credit of the city. The court, however, was divided in its opinion, Judges Barrett, Van Brunt and Williams favoring the constitutionality of the legislation of 1895, Judges Ingraham and Rumsey disagreeing.

Regulating Street Car Fares.

The California State Railway Commission proposes to exercise control over the regulation of street-car fares. It will investigate the cost, debt, expenses and earnings of the roads, and in the event of refusal to give the desired information the matter will be carried to the courts.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS.

DYNAMOS, MOTORS AND TRANSFORMERS.

Alternating-Current Transformers. FLEMING. Lond. *Elec. Rev.* and *Elec. Eng.*, July 17.—The beginning of a reprint in full with illustrations, of his four Cantor lectures; in these he discusses the action, the construction, the testing and the employment of the transformer. In the first he calls attention to the importance of the magnetizing current, estimating that in the United Kingdom the weight of the iron used in the transformers amounts to about 400 tons, requiring at least 400 kilowatts to maintain the magnetization; this at 4000 hours a year amounts to 1,600,000-kw hours, corresponding to about 8000 tons; he discusses the word induction and believes that in practical work it is better to abandon the term number of lines of force, or induction, and to think of induction as a physical effect the value of which is reckoned in webers, the induction being produced in the magnetic circuit by magnetic force, just as electric current reckoned in amperes is produced in the conducting circuit by E. M. F.; a unit of magnetic induction called one weber is an amount of induction which when linked or unlinked with a circuit of one turn and having a resistance of one ohm causes one coulomb to flow around the conducting circuit; the number of webers multiplied by the linkages will then equal the number of coulombs multiplied by the resistance in ohms; in practice the microweber would be used in each case and the above relation then holds true if microcoulombs are substituted for coulombs; one microweber corresponds to 100 lines of force; he gives a number of illustrations of the methods of measuring induction. A classification of all transformers is given, the most important kind being the constant-potential, closed iron-circuit transformer. He shows the importance of graphical delineations of the various periodic quantities concerned, and describes the method which he used for obtaining these curves, in which he used the revolving contact-breaker; a number of curves of different currents are reproduced for both inductive and non-inductive loads; from some of these he shows that when an alternator of 2000 volts is worked on a water resistance the load is absolutely non-inductive, showing that such a resistance may be used, and that in such tests a measurement of the current may be taken as a measurement of the voltage, and the two may be multiplied together to give the power; he also shows that on an inductive load the difference of phase between the current and the voltage is different at different parts of the curve; in one case there was no difference for the maximum values, but a great difference at zero; the form of the current or voltage curve is not necessarily a fixed attribute of the alternator, as it depends largely on the nature of the load.

Self-Induction in Alternating Armatures. BRESLAUER. *Elek. Zeit.*, July 16.—A continuation of the discussion in the form of a reply to the remarks of Benischke (see *Digest*, July 18). It is followed by a communication on the same subject by Kuebler.

Synchronous Motors. DUBSKY. *Elec. Eng.*, July 29.—A continuation of his article on the Budapest exhibition, the present portion being devoted to a description of the Ganz single-phase self-starting motor with the Blathy starting device. These motors are all self-exciting, have a stationary armature, a revolving field and a commutator fixed on the shaft (for the field current); the armature and the field magnet are in parallel and an alternating current passes through them; a choking coil is placed in the armature circuit for starting; the alternating voltage for the field magnet at starting should be four or five times greater than at full speed, and therefore, the full voltage of the main is applied during starting, while for regular running when the motor acts, a transformer is used to reduce it; to reduce the spark at the commutator the field windings are short-circuited by a second brush just a little before the alternating voltage changes its sign; diagrams are given showing the connections for the starting device; the motors can be started only for no load, as the starting torque is quite small, and they must therefore be provided with two pulleys or some equivalent device.

Alternating-Current Motor. D. C. JACKSON. *Elec. Rev.*, July 29.—A reprint, apparently in full, of the paper read before the Northwestern Electrical Association, abstracted in the THE ELECTRICAL WORLD, July 25.

LIGHTS AND LIGHTING.

Negative-Resistance. G. F. FITZGERALD. Lond. *Elec.*, July 17; a continuation of the discussion of this subject (see *Digest*, last week).—He thinks the whole question is simply one of convenience of definition; it will be difficult to describe the "very far-fetched nature" of the quantity which has been called the negative resistance of the arc, and the application of the phenomenon makes it difficult to get a really satisfactory term for it; there seems some reason in the objection to use the term resistance at all for what certainly involves the change of resistance with current; the theoretical *à priori* objections to negative resistance do not seem of much importance as we know too little about resistance; nobody suggested that a negative resistance could exist alone in a circuit any more than a back E. M. F., which answers one of Thompson's arguments (see *Digest*, July 25); he answers another point made by Thompson regarding distributed adjuvant E. M. F.; there seems to be good reasons for expecting that wherever there are Peltier effects and differences of temperature at different junctions, with variations of temperature between, in some of these latter regions there should be adjuvant Thompson effects, that is, negative resistances; hence from Thompson's own examples "it seems almost impossible but that the very negative resistance he so objects to should exist in some part of the arc"; as it requires no differences of temperature to transform directed energy into heat, but it does for the reverse operation, there is some ground for not using the term resistance for any reversed thermal phenomenon, and therefore the term adjuvant Thompson effect is preferable for any distributed thermal action which helps the current; if this use of the term resistance were recognized, the term negative resistance would generally imply a failure of the second law of thermo-dynamics: some other name ought therefore to be given to that phenomenon. Editorially it is suggested that it is time that the term electrical resistance should be more accurately defined so as either to cover or to exclude effects arising from a temperature gradient.

Voltaic Arc. ARONS. *L'Elec.*, July 18.—An abstract of an article from the *Wied. Ann.*, which appears to be the same as the one abstracted in the *Digest*, March 14, and referred to June 6. In addition to what was given there, he found that while an arc can be established between the electrodes of carbon or of metal with a continuous current, yet with an alternating current at a voltage of even 10 or 12 times that necessary to produce the arc under ordinary circumstances, it was impossible to obtain an arc between two metal electrodes, while with carbon a very intense arc 1 cm in length can be produced.

The Light of the Future. HOSPITALIER. *L'Ind. Elec.*, July 10.—A short article pointing out the direction in which we may look for a solution of the problem, with a brief reference to the recent lamps of Edison, Moore and Tesla, which he considers are a step in the right direction. He points out the advantages of cold light and of sources of light of less intrinsic brilliancy over those in which it is very high, as in the arc; he gives a table showing the number of calories (kg-C) generated per carcel hour by various forms of illuminants, showing the progress which has been made; among these are the following: For an ordinary gas burner of the older type, 1000; the Welsbach burner, 100; the Denayrouze burner, 50; acetylene, 75; incandescent lamps, 26; the same when forced, 20, and for the ordinary 10 ampere arc, 5; little improvement can be hoped for in the incandescence of carbon, which is limited by the temperature of volatilization.

POWER AND HEAT.

Traveling Cranes. ADAMSON. Lond. *Elec. Rev.*, July 17.—Referring to a recent discussion (see *Digest* last week), he claims that it is a disadvantage instead of an advantage of a one-motor crane that it is capable of starting rapidly, as this causes the load to swing; he cites a case in which for this reason three motor cranes were made to replace rope cranes.

Transmission of Power at Rheinfelden. RATHENAU. Lond. *Elec. Eng.*, July 17.—A brief abstract of his recent paper (see *Digest*, July 25) together with some of the illustrations.

Electric Plowing. ZIMMERMANN system. *L'Elec.*, July 18.—A brief illustrated description of this system with the results of some tests.

Hot-Presses with Electrically-Heated Gloss-Boards. Lond. *Elec.*, July 17.—An abstract of the article noticed in the *Digest*, July 18, including a table of results of a test.

Test of an Electric Elevator. MACGREGOR and KINGSFORD. *Elec. Eng.*, July 20.—A reprint of a thesis giving the results of some tests of an elevator with which the Leonard system was used. A brief description is given of the plant and the apparatus; some difficulty was encountered in the indicator diagrams, which were finally made on a continuous strip; the tests refer chiefly to the mechanical engineering features of the plant; the results are given in a number of tables and some curves; the average kw-hours per car mile were 2.70; a curve shows the combined efficiency of motor and elevator gear, the maximum of which was 69 per cent., a probable maximum of 72 per cent. being indicated. It is thought that it

would have been preferable to have used one engine instead of independent units for the three elevators, as the motors frequently returned energy to the engines.

Steam Engines for Electric Generators. SPERRY. *West. Elec.*, Aug. 1.—A reprint, with illustrations, of a recent paper read before the Engineers' Club at Cleveland.

TRACTION.

Disturbances in Telephone Circuits Due to Railway Currents. BEHN-ESCHENBURG. *Elek. Zeit.*, July 16.—A description of some conclusive tests made to locate the source of disturbances; the tests were made at night on a line at Zurich running on a grade; accumulators were used as the source of current at the central station, and there was only the test car on the line. In the first test the car was on the middle of the line and was raised from the rails, the motors being run with the brakes partly on, connection being made to the line and rails; it was found that precisely the same noises were heard in the telephone circuits as when the car was running on the rails. In the second test a wire resistance was placed on the car capable of carrying the maximum current used by a car at the full voltage; the car was allowed to descend the grade by its own weight, the speed being properly regulated by means of the brakes; the current passed through the trolley-wheel, the dead resistance and the car-wheel, but not through the motors; under these conditions not the slightest noise could be detected in the telephone circuits, and it was not possible to notice by the telephone whether the car was running or not. These experiments showed that the disturbances were not due to contact resistance at the trolley or at the wheels. In another test the return circuit of the telephone was made through a neighboring telephone line, and the circuit was disconnected from the earth; under these conditions only very weak noises due to the railway currents could be heard; it appears therefore that the direct inductive action was negligibly small. An important feature in such tests is the sensitiveness of the telephone membrane for definite vibrations; another is the extent of the telephone circuits and the conductivity of the earth; for such tests he recommends small alternating-current transformers in which the main current passes through the few primary windings, while a telephone is connected to the secondary.

Accumulator Traction. Lond. *Elec. Eng.*, July 17.—An interview with Mr. Ross with reference to the combined accumulator and trolley system, in which the cars are run with the ordinary overhead trolley system in the suburban portions of the town, each car being also supplied with accumulators, which are charged while the car is running on the trolley wire, and are then used as a source of power in the built-up portions of the city where overhead wires are not allowed; as the latter portions are usually relatively small, the capacity of the accumulators is small; a few cars were started on this system at Hanover in September, where a regular service is now maintained with 35 cars; the results are better than those obtained when the trolley system alone was used; the expenditure of coal is less, due to the regularity of the supply; the accumulators are connected in parallel with the motor and thereby aid the car in starting; for large plants he does not think the saving in coal will be very much; further experience is required before the true cost can be obtained; the same system is used in Dresden.

Traction Diagrams. TOMLINSON. Lond. *Elec. Rev.*, July 17; a continuation of his article (see *Digest* last week).—He discusses the subject of curves and the effects of curves in increasing the energy required to make up for the time lost in friction and subsequent acceleration; the traction per ton around curves is discussed, as also the subject of air resistance; this gives all the information for plotting the complete traction diagram of the draw-bar pull, as also the diagram for the power required; he applies this to an actual line.

Central London Railway. Lond. *Elec.*, July 17.—The construction of this line has now been actively commenced, and it is expected that the 6.5 miles of boring of the tunnels will be finished by the end of 1897, and that the line will be open 2.5 years from now. (This line will be similar in many respects to the existing City & South London line, and consists of deep tunnels.)

Electric Railway on the Isle of Man. Lond. *Elec. Rev.*, July 17.—An illustrated description of the new line which has just been completed, from Douglas Head to near Port Soderick; it is characterized by the enormous amount of curves; it seems to have been constructed mostly of American material.

Surface Rail System. PRINGLE and KENT's system. Lond. *Elec.*, July 17.—An illustrated description of the system noticed in the *Digest*, July 18.

The Pull of a Horse. Elec. Rev., July 17.—Steavenson recently found that a powerful horse may for a short time develop nearly six mechanical horse-power on a draw-bar dynamometer and that probably railway horses exerted nearly four horse-power at their maximum; Morin found that a little over five horse-power overstrained the horses even when of short duration; tram cars when started are absorbing three to four times the work which a horse can continuously perform; Watt's horse-power was avowedly 50 per cent. in excess of that of an average horse; it need therefore cause no surprise that when mechanical means are used for traction a much greater power is required than what at first sight seems necessary; furthermore the motor at starting or running slowly is not running economically.

Electric Railway from New York to Philadelphia. Elec. Rev., July 29.—An announcement that an important deal has just been consummated involving the purchase of the companies having franchises for this road, by a syndicate of Philadelphia capitalists; work on portions of the road will be started immediately.

Compressed Air Traction. PARKE. *West. Elec.*, Aug. 1.—A reprint of an article on a right way and a wrong way to place compressed air in competition with electric power for street railways.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Central-Station Accounts. Lond. *Elec.*, July 17.—A supplement in the form of a large folded plate giving a table "which shows the total capital outlay, receipts and expenditures for the year 1895 of the statutory electric supply undertakings in London and the provinces." No editorial summary is given.

Gas or Electricity. ROSS., *Elek. Zeit.*, July 16.—A reply of some length to a recent pamphlet which was published in the interests of the gas industry; in the present article the errors and wrong deductions which it contains are pointed out.

Detroit Municipal Lighting Plant. Elec. Eng., July 29.—A brief, illustrated description, with a list of the construction and operating costs of this plant, which has been referred to in arguments for and against municipal ownership.

The *Elec. Rev.*, July 29, also contains an article on this plant taken from the first annual report of the Public Lighting Commission.

Mistakes of Municipal Control. BEAN. *Elec. Eng.*, July 29.—A reprint of a discussion of the operating costs of the South Haven, Mich., combined municipal water works and lighting plant, the author being president of a company owning a plant; he explains the low charges at that municipal plant by stating that the entire tax-paying community is taxed in order to furnish electric lights to some of the citizens at less than cost.

Combined Electric Lighting and Traction Plants. HESKETH and RIDER. *Elec. Rev.*, July 29.—A reprint, apparently in full, of the Municipal Electrical Association paper noticed in the *Digest*, July 4.

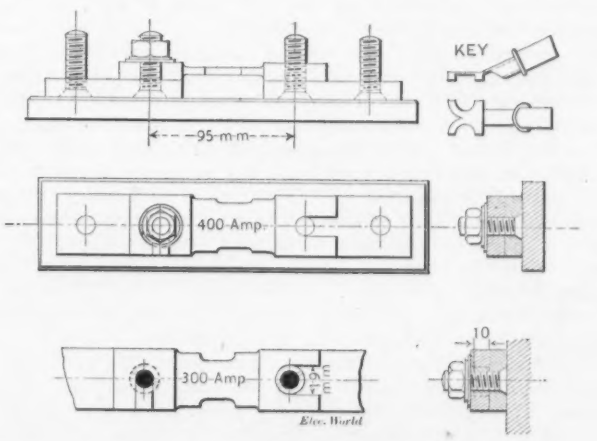
Lightning Arresters. GARTON. *West. Elec.*, Aug. 1.—A reprint, apparently in full, of the recent paper read at the Northwestern Electrical Association, an abstract of which was given in THE ELECTRICAL WORLD, July 25.

The Insurance of Electrical Plants. PIERCE. *West. Elec.*, July 25.—A reprint in full of a paper read before the Northwestern Electrical Association, abstracted in THE ELECTRICAL WORLD, July 25.

Automatic Potential Arrester. JOHNSON and STEEL system. *Elec. Rev.*, July 29.—A reproduction of the illustrations of the apparatus described in the *Digest*, last week.

WIRES, WIRING AND CONDUITS.

Non-Interchangeable Fuses. RITTERSCHAUSSEN system. *Elek. Zeit.*, July 16.—A reprint, with the illustrations, of this system for which the prize of $75 was awarded by the German Union of Electrical Engineers, as the best of the systems offered. The system is shown in the adjoining



illustrations; the fuse consists of a strip of fusible material fastened to two copper end pieces by means of which it is clamped; the chief novel feature is that the slots in the end pieces, as also the pins around which they go, are of different diameters for different currents, so that none but a fuse of a certain capacity will fit the clamping device; in the illustration, for instance, the fuse for 300 amperes has a wider slot and pin than the 400-ampere fuse and the latter could therefore not be placed on the terminals for the former; by having the different sizes of pins corre-

sponding to the different currents and having them different at the two ends, a sufficiently wide range of variation is provided for; to make a pin wider in order to adjust it for a smaller fuse, a collar of the proper size is screwed on as shown in the lower part of the adjoining figure; this requires a special form of key, also shown in the figure.

System of Street Mains. Lond. *Elec. Rev.*, July 17.—A brief, illustrated description of the system used at Guildford. It is what is known as the safety concentric system, each cable being composed of a copper core covered with insulation and then served with an outer conductor of stranded iron wire which forms the return circuit and is not insulated, although it is protected from possible electrolysis by being served with a light protecting covering of bituminous juice; the cables are held in a V-shaped trough of wood filled with bitumen; there are no surface boxes, the joints being made direct onto the cable, by means of a specially cast joint, and then buried in the ground.

Loss of Voltage in Three-Phase Circuits. Heyland. *Elek. Zeit.*, July 16.—A continuation of the discussion, in the form of a brief note replying to that of Rasch (see *Digest*, July 18).

Cable Specifications and Tests. Jeckell. Lond. *Elec.*, July 17.—A reprint in full with the discussion of his recent Municipal Association paper, which was abstracted in the *Digest*, July 4.

Relative Cost of Iron and Copper as Conductors. Allen. The *Technic*; reprinted in the *Elec. Eng.*, July 29.—A table showing the relative cost of copper in cents per pound, as compared with wrought iron, Bessemer steel and cast iron in dollars per ton, assuming the equivalent carrying capacity. To show the saving in the use of Bessemer rails, for instance, at $25 per ton, an estimate is made for transmitting 1000 amperes at 500 volts, three miles, with a loss of 5 per cent.; after allowing $400 a mile for bonding, the saving is over $4000, or $1,363 per mile.

ELECTRO-PHYSICS AND MAGNETISM.

Surviving Hypothesis Concerning X-Rays. Lodge. Lond. *Elec.*, July 17.—An article devoted mainly to an exposition of the meaning and bearing of a mathematical prediction by Helmholtz, made in 1893, at which time he accurately described, as regards reflection and refraction, the behavior of the numerous varieties of X-rays now known; he summarizes in a very lucid way the present state of our knowledge of the Röntgen and Lenard rays; the recent discovery of Henry, Niewenglowski and Becquerel, that certain salts of zinc, calcium and uranium exposed to strong light will emit an invisible radiation, has strengthened the theory that X-rays are ultra-ultra-violet light; the Becquerel rays are capable of polarization, and hence are certainly transverse disturbances, like light, and can also be reflected and refracted, but, like X-rays, are not deflected by a magnet; the assertion that X-rays can be so deflected after passage through an electrified plate has not been substantiated by careful experiments made by him; it is therefore almost certain that X-rays are simply an extraordinary extension of the spectrum, far beyond the ultra-violet, and that the Becquerel rays are a less extreme extension in the same direction; Poincaré suggested in January that bodies which fluoresce strongly enough, no matter how the fluorescence is caused, may perhaps emit X-rays, and, if this is true, the X-rays would no longer be producible only by electric means; this was followed by the discoveries of Becquerel and others. He then discusses the dispersion theory of Helmholtz, which he considers extremely interesting; it is contained in the *Wied. Ann.*, Vol. 48; Helmholtz shows on electromagnetic principles that ethereal radiation of increasingly smaller wave-lengths should become more and more refrangible up to a certain maximum, and when still shorter, the refractive index should suddenly drop nearly or quite to zero, thus doubling the spectrum back upon itself, which would be accompanied by extreme opacity; for still smaller wave-lengths the opacity would become less obtrusive and the refractivity would remain small, but be probably negative; for still smaller waves of atomic dimensions it would become nothing and the opacity would be very small. The material atoms might be said to act as if they loaded the ether; all very coarse waves would be refracted about the same amount, but a new phenomenon would occur for smaller waves as their period might synchronize with some of the periods of atomic vibration, such as enable atoms to emit light, when a violent absorption might be expected; fluorescent and phosphorescent effects might be expected from the jangled atoms; absorption would then be rapid and dispersion anomalous; for still smaller waves the ether of the interstices can hardly be appreciably loaded, and retardation and refraction therefore abruptly disappear and true absorption nearly cease; to waves penetrating ethereal interstices even conducting matter is fairly transparent; electric displacements no longer excite necessary conduction currents. This indicates the sort of view which is now coming to be almost universally held regarding these rays; the proof will not be complete until their length has been measured, but in all probability they are ordinary transverse ethereal waves moving with a velocity of light at various wave-lengths vibrating some trillions of times a second; by the aid of this highest type of X-rays we may hope to get some insight to the actual structure and appearance of the material molecules. Probably they are excited by Hertz vibrations in the atoms; ordinary light may be due to mechanical or acoustic atomic vibrations, but these X-rays are probably due to surgings of the atomic charges. This he illustrates. Mechanical vibrations of an atom ray emit ordinary light, but its electrical vibrations may quite possibly emit X-rays; there is indirect evidence that atomic weight is approximately proportional to atomic bulk, which suggests that hydrogen may be the best substance to be contained in the vacuum bulbs, together with platinum electrodes, the latter being a dense material and the former having the most rapidly moving atoms; dense bodies would then be more turbid than the rare ones and turbidity might be largely a matter of atomic weight; some numerical deductions are given. It is likely that the energy consumed for X-rays is extremely feeble, and that the rays are of low intensity; their activity depends probably more upon synchronism than upon violence. He gives the formula in Helmholtz's theory and discusses its application for various wave-lengths, the general results of which have been given above. He suggests for a first estimate of the frequency, and therefore the wave length, the measuring of the percentage of X-rays reflection from a substance of known dispersive power; still better by measuring the deviation if possible. In an addendum he quotes from an interesting prediction of Prof. FitzGerald in January and refers to a similar one of Prof. Schuster; the former predicted at that time that they are very short waves; he also suggested that we may yet learn how to photograph the molecules themselves by means of these very short waves.

Charges and Electric Figures on the Surface of a Crookes Tube. Villari. Lond. *Elec.*, July 17.—A brief mention of a paper from the Italian describing some experiments. He blew a mixture of sulphur and minium on the glass of a tube at work; generally there was a patch of minium coinciding with the fluorescent spot, the sulphur spreading uniformly over the rest of the tube; there was no red patch if the cathode rays were stopped by a sheet of platinum; the glass is thus negatively electrified where it is impinged upon by the cathode rays and positively everywhere else.

New Form of Crookes Tube for Röntgen Rays. Colordeau. *L'Ind. Elec.*, July 10, and *L'Elec.*, July 18.—A reprint of the Physical Society paper abstracted in the *Digest*, July 18, together with the discussion; in the latter Chappius stated that the small tube suggested by Colordeau would become hot and be melted, when used with strong currents; Colordeau in reply stated that he had used them with the largest coil in existence and without injury to the tube; instantaneous photographs were made with them and showed very good results, even the details of the bones.

Alternating-Current Rushes in Condensers. Scattergood. Lond. *Elec. Rev.*, July 17.—The first part of an article describing a phenomena which he noticed and studied and which he termed a current rush because of a certain similarity to the well-known transformer effect, although the cases are not altogether parallel; the condenser was connected in series with a 16-cp 100-volt lamp, across a pair of 2000-volt mains; the current through the lamps was estimated to be about 0.15 ampere at something less than 30 volts; if the circuit were broken suddenly the lamp went out at once, but if a small arc was allowed to form at the break the current seemed to increase considerably, the lamp lighting up to 80 or 90 volts; it was possible to maintain this state of affairs by carefully adjusting the spark gap, a stream of sparks then passing between the two electrodes; the voltage of the lamp increased to over 100 volts, judging by the eye, and the lamp remained glowing steadily; the same effect was produced when one pole of the high-tension mains was connected through a lamp to one of the primary terminals while the other pole was allowed to spark to a secondary terminal or to the iron core, the two coils or the core acting as a condenser; the probable cause is discussed and it was concluded that the result could be due only to a variation in the E. M. F. or the frequency; but a measurement showed that the voltage across the condenser actually fell from 2000 to 1700; there appeared to be one particular length of spark gap for which the voltage rose 10 per cent. and after which the lengthening of the spark gap lowered the voltage; the pressure therefore falls while the current increases, showing that it is the frequency which increases; it is known that the discharge current of a condenser is oscillatory and that this is the case also with the charging current; the phenomena seems to be of this class; he shows that these oscillating currents are produced in this circuit and discusses it mathematically, giving a numerical example; he also describes and illustrates a hydraulic analogy.

Influence of the Form of E. M. F. Curves on Hysteresis Losses. Aliamet. *L'Elec.*, July 18.—A description accompanied by a number of illustrations of the graphical method of investigation used by Feldmann, accompanied by some examples; it is shown that a primary E. M. F. having a pointed curve is preferable to one having a flat top curve; this is of importance in the destruction of alternators; he refers to some tests made by Neustadt with transformers in which he found that the loss in the iron was not the same for different shaped curves; with a pointed curve the loss was 301 watts on open circuit and 257 when loaded, the frequency being 40; with a flat-topped curve the loss at no load was 262 watts, while at full load it was 296, the frequency being 42; this agrees with the results obtained graphically.

X-Ray Tube. Smith. *West. Elec.*, July 25.—An illustrated description of what he calls an improved focus tube, which is almost precisely like a form described in these columns some time ago. In the large tubes,

which have heretofore been most successful, the surface is too large and the glass fluoresces more or less over the entire surface, generating rays over the whole tube; the heating of the glass also makes it liable to break; in the present form the tube is small and cylindrical, containing a concaved cathode at one end, the anode being a platinum disc inclined at 45 degrees, opposite to which is blown a hemispherical bulb in which the glass is made thin; it is said to give sharp shadows, an illustration of which is shown.

Effect of X-Rays on Germinating Plants. SCHOBER. *Elec. Eng.*, July 29.—An abstract of a recent article from the German, describing some experiments to investigate the similarity between X-rays and ultra-violet light; certain seedlings were exposed to the action of the rays for some time, but no visible effect was produced; he concludes that the new rays appear to differ from light in that they do not stimulate heliotropic curvature.

ELECTRO-CHEMISTRY AND BATTERIES.

Peroxide Electrodes. TOWER. Lond. *Elec. Rev.*, July 17; a short editorial abstract of a recent paper in the *Zeit. f. Phys. Chem.*, Vol. 18, p. 17.—He investigates the subject of peroxides in connection with polarization and its prevention. Among the chief conclusions are that lead, silver and thallium peroxides are unavailable; manganese peroxide was selected for the experiments; a formula is given for the E. M. F. with this electrode; experiments were made with nitric acid and manganous nitrate and the observed and calculated results show satisfactory agreement; the same was true with a number of other acids; the effect of temperature was also determined and was very marked in some cases; the determination of the E. M. F. was also used for the determination of the degree of dissociation of the sodium salts of 16 organic acids.

Separating Silver from Lead. TOMASI. *L'Ind. Elec.*, July 10; a reprint of an Academy paper.—He electrolyzes a solution of lead, which not only has a very low resistance, but does not produce peroxide of lead; the argentiferous lead is cast in the form of anodes; the bath is a solution of the double acid of lead and sodium, or of lead and potassium; the lead is deposited in the form of crystals on the cathode wall, the silver is precipitated; this settlement may contain antimony or arsenic, which may be eliminated by fusion with nitrate of sodium.

The Importance of Electrochemistry in Organic Chemistry. LOEB. *Electrochem. Zeit.*, July 20.—A reprint of a paper of a mathematical nature, with the discussion, read at the recent meeting of the German Electrochemical Society.

Electrolytic Stand. HEATH. *Eng. & Min. Jour.*, July 25.—A reprint from a chemical journal describing a cheap adjustable stand for electrolytic work, especially for the assaying of copper.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Direct Measurement of Mean Spherical Intensity. BLONDEL. *L'Eclairage Elec.*, July 11.—A description of an apparatus which he calls a "photomesometer" for measuring the mean spherical intensity of sources of light which is similar in some respects to his lumenmeter (see *Digest*, June 26 and July 20, 1895.) It is based on the method of making a series of measurements of the intensity of a source in different directions; a method suggested some years ago consists in using a mirror placed at an angle with the axis of a lamp and then made to revolve around a horizontal axis passing through the arc, thus reflecting the light from the arc to the photometer at any desired angle in a vertical plane; the present apparatus is based on this principle, but instead of having one mirror successively in different positions, a large number of mirrors are placed in successive positions around a vertical circle, thus forming a sort of frustrum of a many-sided pyramid; the arc is placed at the centre of this ring of inclined mirrors, and the light passing out at successively equal angles is reflected from the centres of these mirrors; by placing an opaque globe around the lamp and cutting windows through it in the proper positions, the light may be cut off from all but one of these mirrors; by having these windows cut in the proper position the light may be made to be reflected from each of the mirrors in succession and thus the light in each of a succession of vertical angles may be readily measured without the necessity of adjusting the mirror in each case, as heretofore; to obtain the mean on each of two opposite sides of the arc and at the same angles, the two corresponding mirrors may be uncovered at the same time. For measuring the mean spherical intensity all the mirrors are uncovered and the action of each is reduced in proportion to the sine of the corresponding angle, which is readily done by means of an opaque globe having proper-sized openings cut through it, as illustrated and described in the article. In comparing it with his lumenmeter he states that the construction is less expensive than that of the mirror lumenmeter, but more so than one with a conical condenser. The photomesometer furthermore is exact only if the arc is exactly at the centre, while with the lumenmeter it is only necessary that the arc is in the vertical axis; the former is adapted only to the electric arc and not to sources having considerable volume.

Capillary Electrometer in Theory and Practice. BURCH. Lond. *Elec.*, July 17.—The beginning of a descriptive article in which he intends to describe minutely the method of making such an electrometer and to discuss the relation of its physical constants; he will give full details of the apparatus for photographing and measuring the records, and will give photographs of telephone currents; he will describe methods for using the instruments for direct observation. This electrometer was invented by Lippmann in 1875; the author's experience dates from 1886, since which time he has given it considerable attention, making systematic investigations of its mechanical and electrical constants.

Electrochemical Units of Measurement. WILKE. *Zeit. f. Electrochem.*, July 20.—A reprint of a short paper read before the German Electrochemical Society, in which he shows the importance of establishing a uniform system of units; as an illustration he shows the importance of a uniform unit for expressing the current density, for which he suggests the name Alpha; in the choice of such a unit the question of the current density in wires or for medical purposes, etc., should also be taken into consideration, besides that expressing the density in an electrolytic bath; unless the unit is properly chosen to be adapted to all these cases, the result will probably be a number of different units; a committee was appointed to report on this subject; the paper contains no suggestions of what other units are required nor of their best size.

New Method of Tracing Alternate-Current Curves. RODGERS and BURNIE. *Elek. Zeit.*, July 16.—A communication comparing their method (see THE ELECTRICAL WORLD, Oct. 12, 1895) with the one suggested by DREXLER (see *Digest*, May 23 and July 18); it is claimed that the former is equally simple and gives much more accurate results, notwithstanding the claims of DREXLER to the contrary.

Measurement of Tri-phase Currents. DE LA TOUR. *L'Ind. Elec.*, July 10.—Referring to the system suggested by BEHN-ESCHENBURG (see *Digest*, July 4), he proves that that author was wrong in claiming that this method is applicable when the branches are unequally loaded; if the branches are equally loaded the method gives exact results; this is demonstrated in the present article.

Portable Ohmmeter. CHAUVIN and ARNOUX system. *L'Ind. Elec.*, July 10.—An illustrated description of a light, portable apparatus, which appears to be nothing more than a convenient form of Wheatstone bridge with a slide-wire attachment.

Electric Mine Exploder. RAPS. *Elek. Zeit.*, July 9.—A reprint of a recent paper with the illustrations, describing an apparatus made by Siemens & Halske; it is for firing mines in which the explosion is caused by the heating of wires as distinguished from the method in which sparks are used; it consists essentially of a small shunt-wound dynamo, which is turned by hand, the essential improvement being that its action is made entirely independent of the skill of the attendant; the dynamo is driven from a spring which is wound up by the attendant and released at the proper time; at first the energy is used to excite the magnets and at the proper time the external circuit is automatically closed by a pin on one of the train of gear wheels.

Econometer. ARNDT system. *L'Elec.*, July 11.—An illustrated description of this apparatus combined with an electric register; the apparatus is intended to show automatically and continuously the percentage of carbonic acid gas in the flues of a steam boiler, thereby enabling the combustion to be regulated, when read in conjunction with a thermometer in the flue.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Government Telegraphy. DELANY. *Elec. Eng.*, July 22.—An abstract of some length of his recent argument before the U. S. Senate Committee. He discusses government telegraphy in Great Britain and compares it with the proposed service in this country; he believes that without machine transmission government telegraphy would not be practical; he does not think that any government management could conduct a telegraph service on a cheaper basis at the present capitalization and by the present methods than it is now conducted, without the use of a machine system; he thinks that $25,000,000 spent for a system of wires which he suggests, would give better facilities than those now furnished, although it would not reach all the small towns now reached.

MISCELLANEOUS.

Union of German Electrical Engineers. Elek. Zeit., July 16.—The beginning of a full account of the proceedings at the recent annual meeting; the present portion deals with the routine business of the society, and the work and reports of various committees; the papers which were read will be abstracted under their respective headings. In connection with the subject of power transmission, Dobrowolsky pointed out the importance of generating high voltages directly by the alternator, and as an illustration of what can be done at the present time, he exhibited a recent machine of 120 horse-power, having a voltage of 24,000 (see *Digest*, July 18). The discussion is given of the work of the Committee of Rules and Regulations; the rules, which were drafted by them and published some time ago, are not considered ideal, although they are very satisfactory; it is thought that a few years' test may suggest important improvements; it was decided to draft a new set of rules for installations for 250-volt lamps, the importance of which is being felt; considerable approval was expressed with reference to the success of the rules drafted by this committee. A report of the Committee on Copper Standards (see *Digest*, July 25) is given, together with the discussion; it appears that two out of fifteen of the committee were in favor of the C. G. S. system, but the

report as made was adopted. New committees were appointed to discuss the incandescent lamp question, suggestions for which are given, containing rules for permissible variations in incandescent lamps; the question of sockets is also to be considered. A committee was also appointed on the subject of protection against lightning.

Union of German Electrical Engineers. Lond. *Elec. Eng.*, July 10.—A continuation of the record of the proceedings, including also an interview with Mr. Kapp on the work of the association and one with Drexler describing his method of recording alternate-current waves (see *Digest*, May 23; see also July 18).

International Congress of Electricians at Geneva. L'Eclairage Elec., July 4.—A reprint of the programme.

Annual Meeting of the German Electrochemical Society. Electrochem. Zeit., July 5.—A brief report of the proceedings. A somewhat longer report is published in the *Elek. Zeit.*, July 9. The first part of a complete report of the proceedings is published in the *Zeit. f. Electrochem.*, July 20; most of the present portion refers to the business of the society; the papers will be abstracted under their respective headings.

Budapest Conference. Lond. *Elec. Rev.*, July 10.—A brief account of the International Telegraphic Conference.

Prizes. L'Ind. Elec., July 10.—A list of the subjects pertaining to electricity, for which prizes are to be given in 1897 by the Mulhouse Industrial Society.

Biographical. Lond. *Elec. Rev.*, July 17.—A long obituary notice of Sir John Pender.

Starting Dry Oil Wells. Young's method. *Eng. & Min. Jour.*, July 25.—The apparatus consists of an electric heater which can be lowered into the well, generating so much heat that the refuse matter which clogs the pores of the oil stone will be melted and run out; heretofore torpedoes have been used to shatter the stone at the bottom of the well; the electric heater is about three feet long; no further description is given.

Polarity Tester. Keim. *Amer. Elec.*, July.—In one fluid ounce of glycerine dissolve fifteen grains of red iodide of mercury and twenty grains of iodide of potassium; dampen a piece of unglazed white paper with the solution and apply it for about one minute to the poles, which should be about one inch apart for 110 volts, and for higher voltage in proportion, when the spot touched by the negative pole will turn yellow; this method has been found satisfactory in testing circuits from 110 to 6250 volts.

The New York Convention and Exhibition. Mercein. *El'ty*, July 29.—The beginning of a reprint in full of a paper read before the Northwestern Electrical Association, abstracted in The Electrical World, July 25. The *West. Elec.*, July 25, publishes it in full, with the discussion.

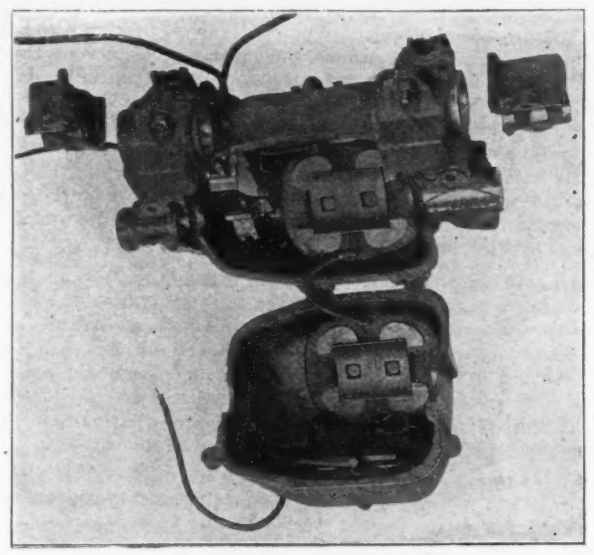
New Book.

Street Railway Investments. By E. E. Higgins. New York: Street Railway Publishing Company. 1896. 274 pages. Price, $3.

The 1896 edition of this publication has recently appeared and contains all the excellent features of its predecessors and is thoroughly up to date. It begins with a review of the year, taking up the cities alphabetically and noting the important changes in the financial affairs, the authorities and the electrical equipment of the electric railways of the United States. Following this comes an alphabetical list of all the cities in the United States and the information concerning the electric railways they contain. First, the location of the town or city, its population and other statistical data are given, then the railways and ship channels and other transportation connections; next, the manufactures and commercial interests are given a brief summarization, then the banking capital of the community. Lastly, the street railway system is taken up, giving a description of the railway, its extent, direction and equipment. Then the capital stock of the road is given, its funded debt that is issued and the conditions under which this was done. A detailed explanation of the financial operation is given, followed by a description of the plant equipment, an enumeration of the officers and directors, location of the general offices and references as to where the road has been described in detail in current technical literature. Lastly, the date of the information is given. Such a book as this is invaluable to an investor to obtain preliminary ideas concerning the enterprise into which he is about to embark his capital, and it also refers him to detailed and complete information which is readily attainable. Besides this it enables the street railway manager to become cognizant of the working of roads in different cities under the systems that they have adopted, and gives him a criterion to judge of their success and formulate a system of his own. The book represents an immense amount of work, and the figure at which it is sold is so reasonable that no one who is financially connected with any street railway interests or any railway manager or supply man can afford to be without one.

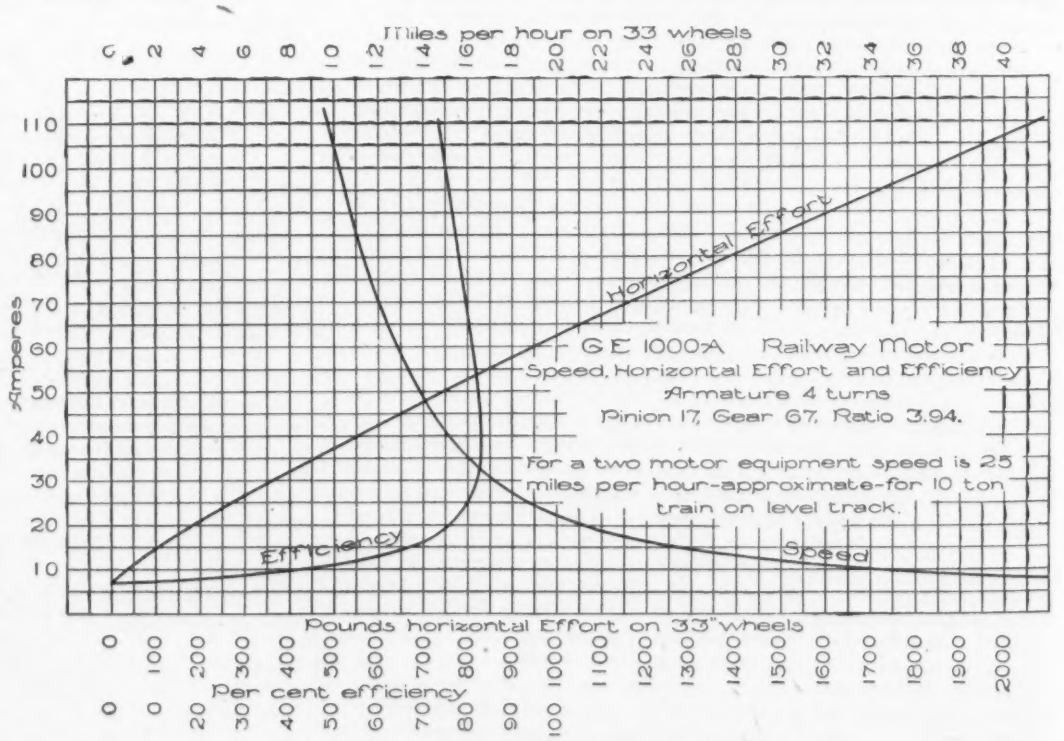
New Railway Motor, G. E. 1000.

The most prominent feature in the development of electric railway work during the past two seasons has been the remarkable increase in



Frame of Motor Open.

the number of suburban and interurban railways, the majority of them operated in conjunction with the city lines. As the same cars are operated from the heart of the city into the suburban districts, a street railway motor of a capacity between that of the G. E. 800 and G. E. 1200 became necessary, to meet the requirements of the virtually dual service. The G. E. 1000, which possesses all the good features of the G. E. motors as well as several striking improvements, has been produced in answer to the demand.

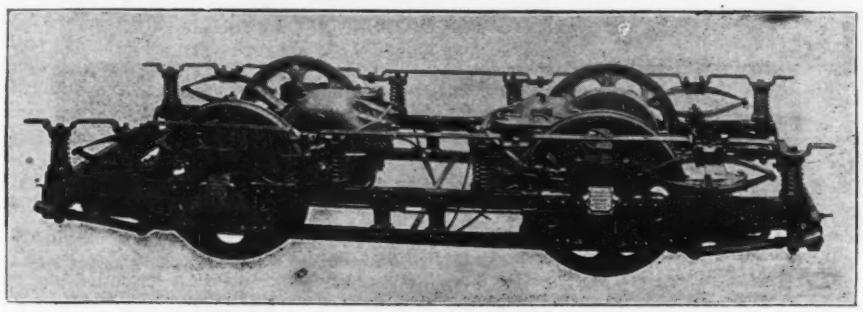

Miles per hour on 33 wheels
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40
Amperes
110 100 90 80 70 60 50 40 30 20 10
Horizontal Effort
G E 1000A Railway Motor
Speed, Horizontal Effort and Efficiency
Armature 4 turns
Pinion 17, Gear 67, Ratio 3.94.
For a two motor equipment speed is 25 miles per hour-approximate-for 10 ton train on level track.
Efficiency
Speed
Pounds horizontal Effort on 33" wheels
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000
Per cent efficiency
0 0 20 30 40 50 60 70 80 90 100

Curves of 2-Motor Equipment.

The armature is of the usual ironclad type with slotted core. The coils are similar in character to those on the G. E.-800 armature with the additional advantage, however, of having the short commutator lead start from the centre of the end of the coil, to facilitate the removal of the coil in case of repair. With this change in position of the short lead, only half as many coils need be lifted when the armature is undergoing repairs. There are 93 coils in all, with four turns per coil. The diameter of the armature is 14½ inches and its weight only 570 pounds.

Two bowl-shaped castings hinged and bolted together form a strong water-tight frame of a type which has never been broken. The lower half can be lowered into the pit, being hinged at the front to the upper half suspended from the axle and a suspension yoke. A hand hole in the bottom of the frame under the commutator allows any foreign matter to be easily removed. The weight of the top field complete is 884 pounds, of the bottom field 495 pounds.

The field coils are interchangeable, and four in number, secured by an extension of the pole-piece secured in turn by two bolts passing through



TRUCK EQUIPPED WITH G. E.-1000 MOTORS.

the frame. One particular advantage of having four coils is that any heating is distributed over a greater surface.

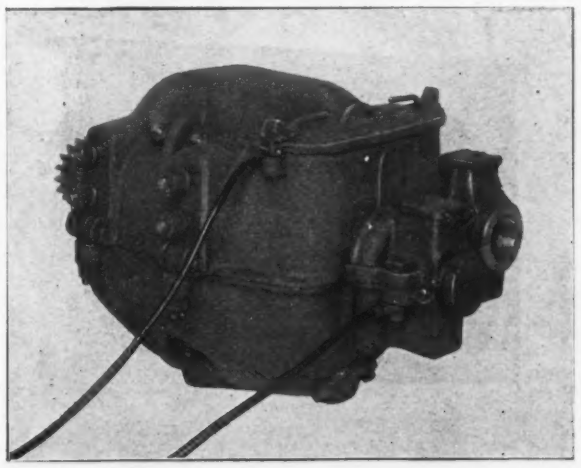
The commutator is constructed without bolts, the clamping ring being held in place by a ring nut and no chance given to oil or other substance to work itself underneath the segments. The surface of the commutator is grooved where the commutator leads are connected in such manner as to form an ear. The advantage of this in case of repair to the armature when moving the leads is obvious. Ninety-three bars of hard-drawn copper, with one inch allowed for wear, are used. The diameter of the commutator is 8¼ inches.

The brush holder is a modified form of that used in the G. E. 800, the brushes being held radially, and the yoke being treated with a special insulating compound with enamel finish to ensure cleanliness and freedom from leakage.

The bearings are of babbitt, and of ample size to secure long life and cool operation. The form is such that oil or grease can be used with equal advantage, without chance of leakage into the interior of the frame.

The gear reduction is 3.94 to 1, and consequently gives a low-armature speed with its advantages.

The suspension of the G. E.-1000 is somewhat similar to that used with the W. P. 50, but differs in that the bar is bolted to the nose of the motor and its ends carried backward toward the axle and attached to the truck frame at points in line with the armature shaft. As this axle is virtually



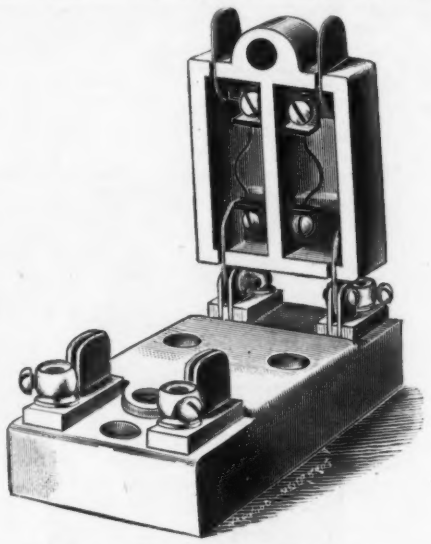
G. E.-1000 RAILWAY MOTOR.

the centre of weight of the motor, the suspension balances the motor and gives an effect equivalent to the side-bar suspension. This method is termed the "Yoke" suspension. By this method of suspension the axle bearings are relieved of the greater part of the weight, and the hammer blow on tracks reduced to a minimum. The motor practically rests upon springs.

The total weight of the motor is only 1950 pounds.

Combination Cut-Out and Switch.

The combination cut-out and switch known as the "Fagan" cut-out manufactured by the Electric Engineering & Supply Company, Syracuse, N. Y., is shown in the accompanying illustration. The device is a double-pole main block with a cover hinged on one end. The fuses are placed in the cover and can be easily replaced. The circuit is broken only when the cover is open This cut-out is designed especially for an entrance



COMBINED CUT-OUT AND SWITCH.

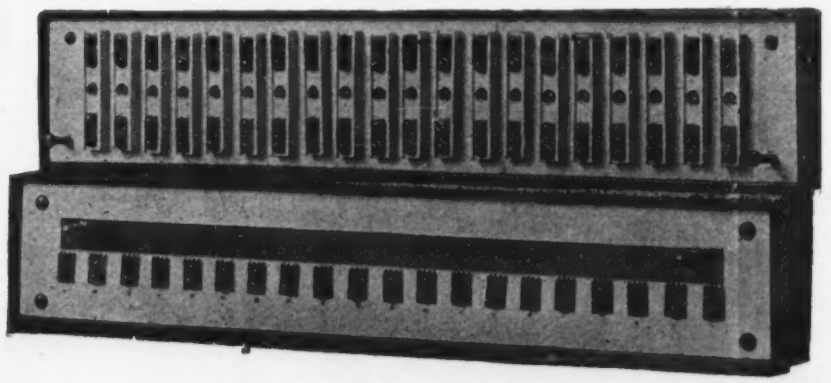
switch, and answers the double purpose of a fuse-block and switch. It can be operated with a cord fastened in a hole at the lower end of the cover and passing through a hole in the base between the two contact terminals, then running along the channels in the back of the base. It hangs down from the ceiling and is easily within reach of the hand. If desired it may be operated with a hook fixed on the end of a pole. It is stated that this device is meeting with much favor among practical men, and the company is enjoying a large demand for it.

New Telephone Switchboard Lightning Arrester.

The accompanying illustration represents a central-station switchboard lightning arrester, which is claimed by the manufacturers, the Missouri Telephone Manufacturing Company, St. Louis, to positively protect the apparatus against damage from high-tension electrical currents as well as against lightning. In its design and construction one of the most important objects aimed at was to so distribute the wires that any one could be readily accessible without interference with any other.

The framework of this arrester is constructed of hard wood, and is painted with an insulating compound, which renders it an insulator itself. On the face of the board are mounted the fuse blocks, and the lightning jaw teeth are protected with ¼-inch asbestos. The line wires run direct to the fuse blocks, thence to the switchboard. Each wire is tapped for connection with the lightning arrester, the terminals of these tap wires being represented by the line of serrated brass jaws, which are set $\frac{1}{16}$ of an inch from the ground bar. By this arrangement the lightning discharge will jump the space between the teeth and the ground connection.

The fuse blocks afford protection against high-tension currents and are



TELEPHONE LIGHTNING ARRESTER.

not designed to avoid the damaging effects of lightning—the lightning arrester takes care of that. The two systems of protection, however, give a combination on one switchboard that is claimed to be absolutely reliable in its action.

The Missouri Telephone Manufacturing Company has equipped some of the largest exchanges in the United States with these boards.

The board is simple in construction and durable, and the company

gives very liberal guarantees with each one installed, and maintains it in working condition. It is stated that operators in exchanges equipped with these boards have so much confidence in the apparatus that they do not leave their seats at the switchboard during thunder storms, as is frequently done in exchanges having the ordinary protective devices.

The Missouri Telephone Manufacturing Company will have a display of its apparatus on the main floor of the St. Louis exhibition this year and informs us that it is the only electrical concern that has been admitted thereto.

Cut-Outs.

We present herewith some illustrations of the McE cut-outs, made by Edward J. McEvoy, Tha nes Building, New York. These cut-outs are made of porcelain, and Mr. McEvoy manufactures a full line of the same

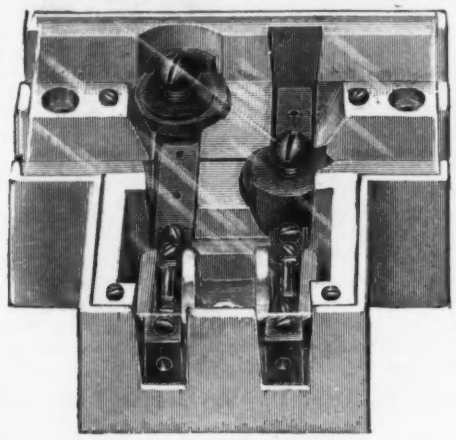


Fig. 1.

for commercial and marine work. In their design some new and valuable features are incorporated, one of the principal ones being the fact that the connections are visible, enabling one to see if any arcing exists.

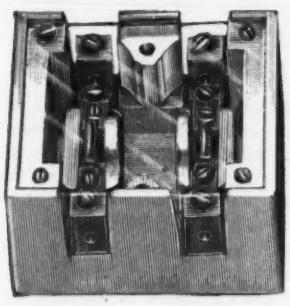


Fig. 2.

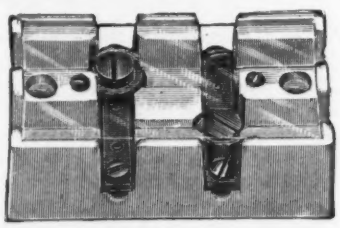


Fig. 4.

The wire connections and terminals are insulated from each other by walls of porcelain, and the devices are so designed that it is impossible to establish a ground connection or a short circuit.

In the illustration, Fig. 1, is represented a branch three-way cut-out,

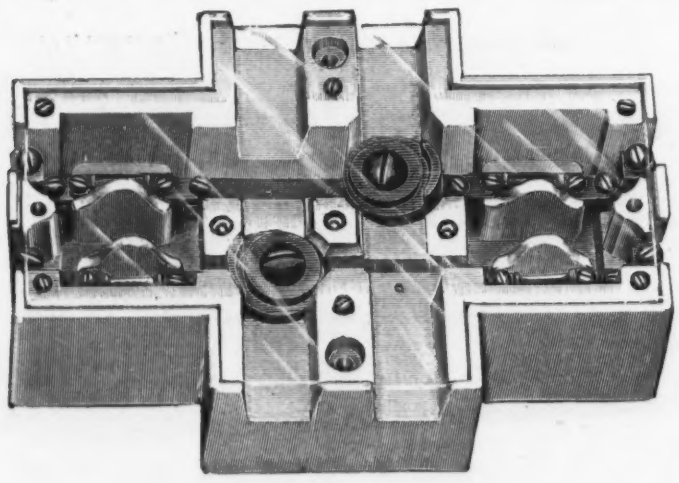


Fig. 3.

and Fig. 2 shows a main line vertical cut-out, while in Fig. 3 is shown a four-way main branch cut-out. The latter device has a carrying capacity of 250 amperes. The metal parts in all three cut-outs are of exceptionally large proportions. The fuses are very easily attached and removed, and all of the connections are made with set screws.

Mr. McEvoy also manufactures five different styles of receptacles, which are constructed on the same general principles as the cut-outs. These receptacles are used on many of the United States men-of-war, including the *New York*, *Columbia*, *Minneapolis*, *Indiana*, *Massachusetts*, *Brooklyn* and *Iowa*.

Regarding the branch cut-outs, the No. 11 size (Fig. 4) is fuseless and is intended to do away entirely with all soldering of the branch wires. Cut-outs of this design are used on the American line steamers *St. Paul*, *St. Louis* and *New York*.

The McEvoy cut-outs are made in seven different sizes and styles, varying from 40 to 250 amperes capacity, No. 8 having a capacity of 230 amperes.

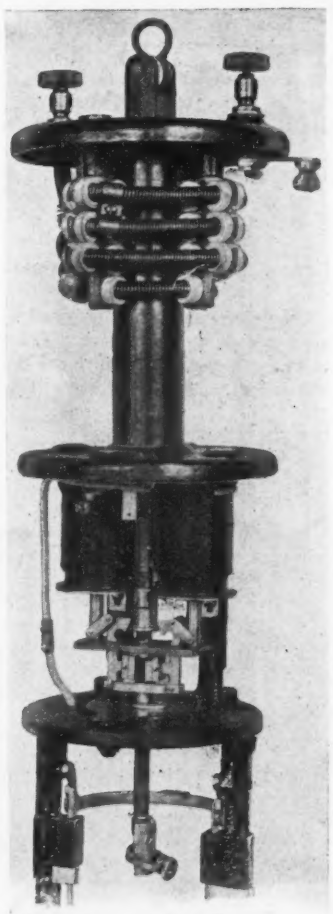
The McEvoy ceiling rosettes possess all of the valuable features of the cut-outs, and are said to be proof against short circuits or grounds. As in the cut-outs, the connections are tightened with set screws, and are so situated that any chance arcing is rendered visible.

Long Burning Arc Lamps.

The possibilities of arc lighting were greatly extended by the discovery that carbon pencils immersed in an inert gas and protected from air currents wasted away much more slowly than similar pencils carrying an arc in free air. It was found also that such enclosed arcs might be safely and steadily operated with nearly double the voltage of ordinary arcs and with a correspondingly decreased current. The results of these discoveries were the construction of arc lamps which require trimming only at long intervals, the enclosed arc and small current allowing carbons to last from 100 to 150 hours actual service.

To the merchant or manufacturer whose premises are extended enough to require arc lighting, the long-burning lamp is a great boon. The daily or more frequent visit of the trimmer is changed to a weekly, or even monthly inspection and trimming; the trouble to customers and possible damage to fixtures or stock by step-ladders, carbon dust or broken globes being reduced in a corresponding ratio. Carbon and current consumption is greatly reduced, enabling a reduction of cost, which benefits both the user of light and the illuminating company.

The less frequent need of trimming and consequent reduction of expenses allows the use of arc lamps in small shops or stores, where formerly they could not be profitably employed.



Interior of Arc Lamp.

Arc Lamp.

One of the simplest long-burning arc lamps is that made by the General Electric Company. The simplicity of the mechanism, which consists of little more than an electromagnet and a friction clutch, is shown in the illustration. Many of these lamps have been installed for several months, and are said to be giving great satisfaction to users, fulfilling completely the claims made for them by the manufacturers.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, August 1, 1896.

THE GENERAL LIST of electrical stocks, on the whole, showed a weakness and absence of activity. Quotations are in general practically lower than last week, and trading was lifeless, being in most cases below the average.

GENERAL ELECTRIC showed a little more firmness on total sales somewhat below the average. The highest point of the week was 24½ and the lowest 22¾, closing at 24. This shows a net gain in the week's transactions of ½ point.

WESTINGHOUSE, which is listed on the Boston exchange, showed a better feeling in the common shares, the closing bid price being 1½ higher than it was last week. Holders are asking 26.

TELEGRAPHS.—Western Union lost 1¼ points net on the week's business, and the number of shares sold were above the average, being 18,858. The fluctuations, however, were confined to narrow limits, the highest price being 79⅞ and the lowest 77½, closing at 78¾. Postal quotations remained unchanged from last week.

TELEPHONES show weakness and a loss in quotations. Bell was bid 199 at the close of the week, which figure is 1 point below that offered at the close of last week.

TRACTIONS.—There was no marked activity in traction securities during the week, Buffalo Railway showing the most life of the list. This was probably due to the announcement of the arrangement made to get some of its power from Niagara Falls. The details of the contract, which is an important one in its significance, are given on another page in this issue. Brooklyn City Railroad stock fell off on limited trading and light offerings.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	..	..
Edison Electric Ill., New York	100	90	93
" " " Brooklyn	100	..	..
" " " Boston	100	..	..
" " " Philadelphia	100	..	..
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	24½	25
Electric Storage, pref	100	26½	27½
General Electric	100	23¾	24
General Electric, pref	100	71	73
Westinghouse Consolidated, com	50	24½	26
" " pref	50	50	..

BONDS.

Edison Electric Ill., New York	105	109	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	85	..

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	199	200
American District Telegraph	100	*29	39
American Telegraph & Cable	100	85	89
Central & South American Telegraph	100	124	127
Commercial Cables	100	125	..
Erie Telephone	100	55	56
New England Telephone	100	..	95
Postal Telegraph-Cable	100	72	75
Western Union Telegraph	100	78⅜	79

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	16¼	16½
Brooklyn Rapid Transit		20	22
Brooklyn Traction	100	..	14
" " pref	100	46	48
Buffalo St. Ry	100	..	65
Cleveland Electric Ry	100	..	..
Columbus St. Ry	100	38	41
Hestonville	100	48	50
" pref		..	62½
New Orleans Traction	100	9	12
" " pref	100	..	60
North Shore Traction	100	20	22
" " pref	100	68	72
Rochester St. Ry	..	15	20
Steinway Ry	..	45	50
Union Railway (Huckleberry)		98	105
Union Traction, rcts $10 pd	..	12¾	13
West End, Boston	100	64	64½
" " pref	100	85	..
Worcester Traction	100	14	16
" " pref	100	..	88

BONDS.

Brooklyn Rapid Transit 5s, 1945	100	77	..
Buffalo St. Ry. 1st con. 5s	100	104	*107
Cleveland Elec. Ry. 1st mtge 5s	100	100	*103
*Columbus St. Ry. 1st 5s	100	93	*97
Rochester St. Ry. 1st 5s	100	99½	*102
Union Railway (Huckleberry) 1st mtge 5s		102½	105
*Westchester Electric 1st mtge 5s	100	100	102

* With accrued interest.

DIVIDEND.—A quarterly dividend of 1 per cent. will be paid by the Erie Telegraph & Telephone Company, Lowell, Mass., on August 17.

BONDS OFFERED.—The Boston Electric Light Company offers the $270,500 of its 5 per cent. consolidated bonds now in its treasury to stockholders at par and interest, and to the public at 102 and interest.

BONDS.—The Stock Exchange has listed $5,500,000 of 5 per cent. 30-year consolidated mortgage bonds of the Milwaukee Electric Railway & Light Company, of Milwaukee, Wis. The total authorized issue is $8,000,000, but the balance is held in reserve.

STATEMENT.—The New Orleans Traction Company reports gross earnings for June of $113,563, a decrease of $8,371 as compared with the same month of last year, and net $47,610, a decrease of $7,289. For the six months ending June 30 the gross earnings were $681,726, an increase of $40,369 as compared with the corresponding period of last year, and net $304,336, an increase of $23,450.

NEW STOCK OFFERED.—The New England Street Railway Company, New Haven, Conn., offers to its stockholders for subscription $100,000 of the stock of the Winchester Avenue Street Railway Company, which is owned by the New England Company. The stockholders may subscribe until Aug. 15 at par ($25), in proportion of one share for 11 held. The new money is to be used for extensions and improvements.

INCREASE OF STOCK.—A meeting of the stockholders of the Third Avenue Railroad Company has been called to vote on a proposed increase of $3,000,000 in the capital stock of the company. The proceeds of the new stock, it is explained, will be used to extend the road along the Boulevard and King's Bridge, and for other improvements. Each stockholder will be entitled to subscribe at par in proportion to his present holdings. In 1891 the capital stock was raised from $2,000,000 to $3,000,000 to pay for changing the motive power from horses to cable. In 1892 there was a still further increase to $5,000,000; in 1893 to $7,000,000, and in January, 1895, to $9,000,000.

ANNUAL REPORT.—The annual report of the Boston Electric Light Company for the year ending June 30 makes a favorable showing. The following figures represent the results of the year's business, with the changes as compared with the figures of the previous year. Total income $660,973, increase $50,708; operating expenses $420,641, increase $9192; net earnings $240,397, increase $41,582; surplus, after paying dividends and charges, $53,680, increase $22,710. In a circular issued July 31 to the stockholders President F. A. Gilbert says: "The directors are of the opinion that for a short time, at any rate, it will be advisable, as suggested by the gas commissioners, for the company to pay a somewhat smaller dividend, say at the rate of 6 per cent. per annum, applying the balance of the profits to the liquidation of floating indebtedness and to the cost of future additions and improvements. They believe that this will increase the value of the company's stock and bonds." The valuation of the real estate of the company has been increased by appraisal by more than $100,000. The annual meeting of the company will be held on Aug. 11.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, August 3, 1896.

MR. GEORGE FRINK SPENCER, manager for the firm of I. P. Frink, has just returned from an extended trip abroad, combining business with pleasure.

MR. W. C. ARMSTRONG has secured a position in the sales department of the Electric Arc Light Company, and from now on will book orders for the Pioneer lamp. His office is at 687 Broadway.

NEW LAMP.—The Electric Arc Light Company, New York, has just put upon the market a new style of enclosed arc lamp, called "Style B." It is graceful and ornamental, and should find favor with the buyer. It is reported that large orders have been placed for this new lamp.

DISSOLUTION.—Justice Andrews, of the Supreme Court, on July 24 dissolved the Solar Electric Company, 75 Duane Street, and appointed Hon. Jacob Rice, of Kingston, N. Y., permanent receiver. The liabilities of the company are said to be $16,700 and the assets $8794.

THE ECLIPSE ELECTRIC LAMP COMPANY.—The sheriff has taken possession of the office of the Eclipse Electric Lamp Company, 136 Liberty Street, New York, on executions in favor of several companies for various amounts. The Eclipse Company's factory is in Buffalo, N. Y., and it has a branch at Elmira, N. Y.

PEACE RESTORED.—It is announced that the fight between the rival unions of electrical workers has been terminated by the consolidation of the two rival bodies. The unions involved were the Electrical Worker's Union No. 3 and Electrical Workers' Union No. 5. Under the new arrangement No. 5 will go out of existence and No. 3 will survive.

JUDGMENT.—Judgment for $35,271 was entered on July 29 against the Ball Electric Light Company, of this city and Chicago, in favor of Royal E. Ball for royalties on his patents for manufacturing regulators for dynamo-electric machines. President Brown, of the company, said that the judgment was a friendly one to protect Mr. Ball's interests, as he is the largest stockholder.

ALLEN R. FOOTE.—This gentleman, who is well known to the electrical constituency, has offered himself as a candidate for nomination to the regular Republican organization for the Eleventh Congressional District, City of New York. Mr. Foote has a great many friends in the electrical business, who, no doubt, will give what support and encouragement they can towards securing his election.

THE MAGNETIC CLUB.—The Magnetic Club held its annual dinner and outing at College Point, L. I., on July 30, and the affair proved to be the most successful and enjoyable of any of its kind ever held by the club. The Western Union cable steamer, *Western Union*, was placed at the disposal of the members for their transportation from the city to College Point. An attractive programme of sports and games was arranged by the committee and suitable prizes were awarded to the victors in each event. At 7 o'clock dinner was held at the Boulevard Hotel, and after partaking of the feast speeches and instrumental and vocal music were artistically and effectively rendered. President W. H. Baker occupied the chair, and a large number of well-known and representative electrical people were present and enjoyed themselves to the utmost.

New England Notes.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, MASS., July 31, 1896.

IN NEW QUARTERS.—The Electric Storage Battery Company, Philadelphia, has moved its Boston office from the Exchange Building to the Farlow Building, 92 State Street, where it will have more commodious quarters.

ROCKVILLE, CONN.—President Chapman, of the Hartford, Manchester & Rockville Tramway Company, has informed the committee on electric roads, appointed by the town, that he will have a survey made at once of the route for the proposed extension of the road from Talcottville to Rockville by way of Vernon Centre.

ELECTRIC LIGHTS.—The contract between the city and the Worcester Electric Light Company for city lighting which has just been approved provides for arc lights of 2000 candle-power each at 33 cents per night per lamp, and incandescent lights of 32 candle-power at $2 per lamp monthly; both classes of lights to burn all night and every night.

NEW HAVEN, CONN.—The two old suits brought by the Edison Electric Light Company against the New Haven Electric Company were dismissed, without costs, by Judge Shipman in the United States Court at Hartford on the request of the complainants. These suits were for alleged infringements of patents dating almost from the first use of the electric light in this city.

STAMFORD, CONN.—The petition of the New York, New Haven & Hartford Railroad Company for a modification of its proposed location of a trolley road to Darien has been granted. This action, it is stated, will enable the connection of Stamford and Norwalk by trolley. The contract for the construction of the line between Stamford and Norwalk has been awarded to H. Gore & Sons, Boston; the General Electric Company will furnish the electrical equipment.

MR. HENRY B. CRAM and the Bernstein Electric Co., of Boston, have been contemporaneous for these many years, and the announcement of Mr. Cram's resignation as treasurer and general manager of this company has occasioned universal surprise and regret. The electrical field does not possess a more conscientious or energetic worker than has been Mr. Cram. He has done a great deal for the electrical business in Boston and New England, and obtained deserved popularity. As president of the old Boston Electric Club he did much, but as secretary of the New England Electric Exchange he did more, as through this organization a closer union between the electrical and insurance interests was effected, and due in the main to the indefatigable efforts of Mr. Cram. It is yet uncertain as to whether Mr. Cram will remain in the electrical business.

Western Notes.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., July 30, 1896.

IMPROVED TELEPHONE SWITCHBOARD.—The Electric Appliance Company has remodeled its American telephone switchboard, introducing a number of important improvements which, it is claimed, will make the board a very desirable one.

THE PACIFIC ELECTRICAL COMPANY, Tacoma, Wash., has ceased to exist as a corporation in that State, having been purchased by Wisconsin parties. The business will be continued as a new corporation under the name of the Pacific Electrical Company, of La Crosse, Wis.

IN FINANCIAL DIFFICULTIES.—It is reported that the Eureka Tempered Copper Company, Northeast, Pa., is in the hands of the sheriff on executions in favor of the Second National Bank and M. H. Taylor, of Erie, Pa., amounting to $14,000. The sale has, it is said, been fixed for August 6.

PITTSBURG, PA.—The disastrous storm which visited this section on July 27 caused a great deal of damage to electric property. Most of the telephone lines in Allegheny County were prostrated, and both the Western Union and Postal Telegraph Companies suffered much damage of a similar nature.

THE VICTORIA ELECTRICAL WORKS has been recently started in Victoria, B. C. The members of the firm are G. C. Gilbert, R. Hutchinson and D. Deverell. The firm's place of business is at 36 Fort Street. Each of the above named gentlemen is well known in the electrical trade in that section and all are practical electricians.

NEW FACTORY.—The Sunbeam Incandescent Lamp Company, Chicago has discontinued manufacturing in its old factory, and in a week or 10 days will be able to start up in the new one, located at Desplaines, a few miles out of Chicago. The new factory has been fitted up with the very latest modern devices for the manufacture of incandescent lamps.

COAL WASHING.—The Jeffrey Manufacturing Company, Columbus, O., has taken up the manufacture of the Robinson patented coal washing machinery. There are many in daily use in this and foreign countries, and it is conceded to be a most efficient and simple washer. The points of special advantage are its simplicity, compactness, low cost of installation, low cost of operation, economy in the use of water, and its washing of coal that is not closely sized.

THE FORT WAYNE ELECTRIC CORPORATION, Fort Wayne, Ind., has issued a very handsome and complete catalogue of the "Wood" systems of electrical machinery and apparatus for light and power. The catalogue is very fully illustrated and shows the apparatus and accessories complete and in detail. Descriptions of the same are very fully given. The company has also issued a little pamphlet on its self-starting single-phase alternating-current synchronous motors which is illustrated with diagrams of circuits and views of the motors.

FRANCHISES ASSIGNED.—W. E. Brice and L. H. Ong were recently granted franchises for an electric railway in and between Mason City and Clear Lake, Ia. They have assigned the franchises to the Mason City & Clear Lake Traction Company (Incorporated). The latter company has contracted with the Western Engineering & Construction Company, Mason City, to build 17 miles of electric road, including overhead work; to put up the necessary building, install the power plant, and put on an equipment of 20 cars and have them in operation by May 15, 1897. The material, machinery and equipment will be purchased in from ninety days to four months by the Western Engineering & Construction Company.

English Notes.

(From Our Own Correspondent.)

LONDON, July 22, 1896.

A NATIONAL MEMORIAL OF SUBMARINE TELEGRAPHY.—It is thought by many influential people in this country that the death of Sir John Pender affords a fitting opportunity of commemorating the inception of submarine telegraphy by a national memorial, and the scheme seems to have every likelihood of coming to a successful issue.

SCIENCE CATALOGUE INTERNATIONAL CONFERENCE.—The International Conference held in London last week which had for its object the arrival at a common understanding as to the advisability of preparing and the scope of an International Catalogue of Scientific Literature, to be commenced in the year 1900, has come to some important decisions It has been decided that the central bureau shall be in London, that English shall be the language of the catalogue, and that a committee should be appointed to settle all details.

INTERNATIONAL ELECTRICAL CONGRESS AT GENEVA.—Considerable comment is being made in this country with regard to the origin and constitution of the Electrical Congress which it is proposed to hold in Geneva at the beginning of August in connection with the Electrical Exhibition now open in that city, Notwithstanding a circular issued some six or more weeks ago to the effect that delegates from the leading countries of the world would be invited to attend this congress, no such invitations have so far reached this country. Even Mr. Preece, who has attended every International Electrical Congress yet held in the capacity of delegate, has received no request to attend the present one. The promotors of the congress would appear to be MM. Palaz and Cuenod of Geneva, who are respectively well known in connection with electrical science and electrical engineering, but up to the present they have not replied to any letters addressed to them on the subject of this mysterious Congress. It is hoped that the electrical community will not wake up one day to find an entirely new system of units and nomenclature imposed upon it by this so-called International Congress.

MUNICIPAL ELECTRIC LIGHTING UNDERTAKINGS AND DEPRECIATION FUNDS.—The glib gentlemen who see something ineffably excellent in municipal enterprise have long maintained that is quite unnecessary for a municipal electric light undertaking to set aside anything for depreciation of machinery, etc., since it is obliged to set aside something every year toward the redemption of the capital involved. This would be a perfectly correct way of looking at the matter if it were not that none of these loans have to be repaid in less than 25 years, and some of them need not be repaid in less than 50 years, and not even the most enthusiastic and interested electrical engineer could possibly maintain that engines, dynamos, boilers, mains, switches and such like material, even if money be lavishly spent on their maintenance and repair, are likely to last such terms. It is encouraging to see, however, that this plausible argument has not met with the approval of the city fathers responsible for the finances of some of our leading towns. For instance, at Hull, quite recently, when the Borough Treasurer defended the practice of not building up a depreciation fund by the statement that he did not know of any act of Parliament which required that the Corporation of Hull should build up such a fund, an Alderman was found bold enough to remark that he hoped the good people of Hull were governed by common sense as well as by acts of Parliament. At Edinburgh, also, the Lord-Provost said he thought the Council would be in an unsafe condition as to certain parts of the electric lighting undertaking if it did not adopt the suggestion of the Electric Lighting Committee and establish a depreciation fund. There is no doubt, of course, that the sums annually set aside by municipal undertakings for this purpose need not be anything like as large as those of limited liability companies, since in the former case the capital expenditure is being gradually redeemed. But it is, as I have just remarked, distinctly encouraging to find that those responsible for the finances of our large towns are alive to the necessity of carrying out these electric lighting businesses in a thoroughly honest and sound manner.

General News.

LEGAL NOTES.

UNDERGROUND CONDUITS IN MINNEAPOLIS.—Judge Belden, Minneapolis, Minn., has granted a temporary injunction on behalf of the taxpayers to restrain the city from taking further steps towards the construction of the underground electrical conduits and from issuing city bonds, in accordance with the resolution adopted by the Council on July 17. The complainants allege that the issuance of the bonds for this work is illegal, on account of its purpose, as well as because the 5 per cent. bond limit has already been exceeded. The Northwestern Telephone Company has asked the court to issue a writ of mandamus compelling the city engineer to authorize the company to lay its own conduits or show cause why such permit should not be issued. The mandamus was granted by Judge Belden, and Aug. 1 was set as the date for a hearing. The company alleges that it has already paid out about $13,000 for material, and that it will suffer severe loss should permission to go ahead with the work be refused.

THOMSON-HOUSTON ELECTRIC COMPANY, APPELLEE, *VS.* THE KELSEY ELECTRIC RAILWAY SPECIALTY COMPANY.—On July 29 Judge Shipman handed down the opinion, of which the following is an abstract, permitting of the use and sale of trolley bases under certain conditions, thereby modifying the previous order of Judge Townsend:

The Circuit Court of the United States for the District of Connecticut, after an exhaustive investigation of the validity and alleged infringment of letters patent No. 495,443, dated April 11, 1893, and issued to the administrators of Charles J. Van Depoele, decreed that the Winchester Avenue Railroad Company had infringed claims 6, 7, 8, 12 and 16 of the patent. The complainant in the suit was the Thomson-Houston Electric Company, the assignee of the patentees The combination covered by these claims, and now used generally by the electric railways of the country, consisted generally in an electric railway having an overhead conductor and a car for said railway provided with a contact device carried by the car so as to form a unitary structure therewith and consisting of a trailing arm, hinged and pivoted to the car so as to bridge the space between it and the conductor and move freely both laterally and vertically, and said arm carrying at its outer end a contact device capable of being pressed upward by a suitable tension device into engagement with the under side of the conductor.

The important and distinctive part of the invention was the trailing arm hinged and pivoted to the car, and moving laterally and vertically, with a contact device at its outer end capable of being pressed upward by a suitable tension device into engagement with the under side of the conductor. The novel element of "the overhead, under-running, spring-pressed, laterally-swinging contact arm" was of great utility, and has superseded pre-existing attempts at trolley road equipment. The trolley-stand, so called, is the means by which the traveling arm is hinged and pivoted to the car with a capacity for lateral and vertical movement, and is pressed upward by some suitable spring. No particular form of a stand was included in the Van Depoele invention, for any one of a number of forms would answer the purpose.

The defendant, the Kelsey Electric Railway Specialty Company, manufactures a particular form of trolley stand, for which letters patent have been issued, which it has advertised for sale, and has also in its advertisements represented itself as a dealer in trolley poles and overhead trolley equipments. Its trolley stand consisted in the main of a base secured to the car roof, a frame revolubly mounted upon the frame so as to receive the end of a trolley arm, and springs by which tension upon the arm is produced. The Thomson-Houston Electric Company, having brought suit against the Kelsey Company for infringement of this Van Depeole patent, the Circuit Court for the District of Connecticut granted a motion for an injunction *pendente lite* against its making or selling any apparatus embodying the subject matter of, or any trolley bases devised or intended to be used in infringement of these claims of said patent which were found to have been infringed in the Winchester case. The present appeal is from this order.

The question, as presented in the affidavit and briefs, relates particularly to the manufacture and sale of trolley stands. As evidence of an intention to infringe, the complainant relied upon the language of the defendant's advertisement, which offered for sale the stands and overhead trolley equipment generally.

The defendant admits that he has sold trolley stands directly or indirectly to electric companies which purchased their equipment originally from the complainant's licensees, either by way of repair or because the purchasers wanted an improved stand. It denies that it has knowingly sold to an infringer of the patent in suit or to be used for the purpose of infringement. The circuit judge was of opinion that the defendant was selling stands capable of and designed for an unlawful use, and that inasmuch as they are useful only for the purpose of performing functions involved in the operation of the patent, there was a presumption of an intention that these stands should be so used, which was not dispelled by the affidavits.

The question being one of contributory infringement, the applicant urges that there was no sufficient evidence that the defendant had concerted or was concerting, or intended to concert with any person for the infringement of the complainant's patent, and that consequently the injunction order either ought not to have been issued or was too sweeping in its terms.

The case of Wallace *vs.* Holmes (9 Blatchf., 65) was cited as an instance of contributory infringement, and upon which all subsequent cases rest.

The willingness of the defendant in this case to aid other persons in any attempts which they may be disposed to make toward infringement, is also apparent.

The defendant says also that the order which was granted is capable of too sweeping an interpretation, because it has a right to supply purchasers who have acquired the right to use the patented combination, with its trolley stands, either by way of repair, or because the stands which were furnished to them were not adapted to the needs of the cars upon which they were placed, and it invokes the principle upon which was stated in Chaffee *vs.* Boston Belting Company, 22 How., 217, as follows: "If a person legally acquires a title to that which is the subject of letters patent, he may continue to use it until it is worn out, or he may repair it or improve upon it, as he pleases, in the same manner as if dealing with property of any other kind." The complainant, which is utilizing its patent rights by the manufacture and sale of trolley railroad equipments, and desires to compel purchasers to continue to supply themselves with its form of stands, replies that the defendant's sales are not for the purpose of repair, but are for the reconstruction of the patented combination; and that a reconstruction of a destroyed or worn-out combination is an infringement. This proposition is true, and examples of the cases to which it is applicable are found in Cotton Tie Company *vs.* Simmons, 106 U. S., 89, and Davis Electrical Works *vs.* Edison Electric Light Company, 60 Fed. Rep., 276. In the Cotton Tie case, the continued use of patented ties, which consist of a band and buckle, was purposely destroyed by the purchaser, by cutting the band after he had received the bale around which the tie was placed, and the parts were sold as waste material. A new purchaser bought the several parts, mended the bands, replaced the buckles, sold them to be used as ties, and was held to be an infringer.

The complainant, recognizing that the facts in these cases are not analagous to those in the record now before us, urges that, in order to constitute reconstruction of a patented device, it is not necessary that the structure should have been destroyed intentionally, or that the vital and peculiar element of the invention should have been worn out by use, but that the substitution of an important member of a patented combination, which was intended to be permanent, in place of the corresponding member which had been accidentally broken or had been worn out, is reconstruction, and that there is a recognized distinction between such a substitution and the replacing of fragile members whose life is necessarily short.

Reliance is placed upon the case of Wilson *vs.* Simpson, 9 How. 108, which involved the question of the interest which the owners of a patented machine had in it, after the expiration of the first term of a patent, where there had been a renewal and extension of it, and which has been sometimes supposed to establish the rule that the replacement by the purchaser of the parts of a patented machine which must, from their nature, be temporary, is permissible, while in no event is the replacement permissible of a part which it was hoped would be permanent.

The court says: "We admit, for such is the rule in Wilson *vs.* Rousseau, 4 Howard, that when the material of the combination ceases to exist, in whatever way that may occur, the right to renew it depends upon the right to make the invention. If the right to make does not exist, there is no right to rebuild the combination.

"But it does not follow, when one of the elements of the combination has become so much worn as to be inoperative, or has been broken, that the machinery no longer exists, for restoration to its original use, by the owner who has bought its use. When the wearing or injury is partial, then repair is restoration, and not reconstruction.

"It is the use of the whole of that which a purchaser buys, when the patentee sells to him a machine; and when he repairs the damages which may be done to it, it is no more than the exercise of that right of care which every one may use to give duration to that which he owns, or has a right to use as a whole."

This distinction is both natural and founded upon right reason, and gives to the patentee all the benefits to which he is entitled by the grant of the patent. While it is not intended that a trolley stand should be broken, or should lose its useful capacity, either calamity may befall it, and the right to replace the injured part by a new stand from any person who can supply the article should be conceded by the owners of the patent.

It is not intended to permit the unauthorized substitution of the vital and distinctively new part of an invention in place of one worn out by use, as the substitution of a new filament in an Edison incandescent lamp, or the substitution of a new for an old burner in the Wallace case (supra), but the trolley stand is not the vital element of the invention, though a portion of it is an element of the combination; it is the means, and in most cases the non-patented means, for there are numerous forms of these bases by which the pole is permitted to perform its functions.

The order is directed to be modified, without costs of this court by adding the words: "It is not intended to enjoin the defendant against the sale of trolley stands by way of replacement of broken stands or stands worn by use, or of substitution for trolley stands previously sold by the complainant to purchasers from it, but this permission does not give authority to reconstruct or build a combination which has been sold by the complainant."

Judge Wallace in dissenting from the above opinion in part, said:

"This case presents in my view an utterly unwarranted attempt on the part of the complainant to enlarge the monopoly which it had acquired as the owner of the patents in suit, and to dominate exclusively the manufacture and sale of articles which its patents do not cover and which others have a legal and moral right to make and sell. The preliminary injunction by which the defendants are restrained from making or vending their trolley stands was granted without a particle of evidence that they had ever infringed any of the claims of the complainant's patents, and, as I think, without the slightest evidence that they threaten to do so. They are as much entitled to make and sell their trolley stands as they are to make and sell the rails, the poles, the wires, the screws, the paint or any other article which may be required for use by those who own and operate electric railways in which the improvements covered by the patents of the complainant are utilized. Concededly they have a right to repair their trolley stands, to substitute new ones for those old or worn out, or to substitute a better and improved kind for those originally bought of the complainant. The defendants have an equal right to make and sell the stands to such owners for that purpose.

"The injunction was granted upon the theory that a case of contributory infringement had been shown. The only evidence of contributory infringement consists in the fact that the defendants are making, advertising and selling their trolley stands to the public. That they are concerting with infringers with a view to assist them in appropriating without compensation the inventions patented by the complainant there is not a particle of evidence. Being entitled to sell their article they are under no obligation before sell-

ing it to inquire whether the purchaser intends to make an illegal use of it.

"One who assists another to infringe a patent is of course a tort-feaser, and whether he is called a contributory infringer, or merely an infringer, is only a matter of nomenclature. But he does not assist or concert with another to infringe merely because he sells him an article which may be used to effect an infringement. In other words, participation in a wrong is not established by doing a lawful act without evidence of an unlawful intention.

"I think the order granting the preliminary injunction should be reversed."

New Incorporations.

THE ZANESVILLE STREET RAILWAY AND ELECTRIC COMPANY, Zanesville, O., has been incorporated with a capital stock of $500,000.

THE AURORA & GENEVA RAILWAY COMPANY has been formed at Aurora, Ill. The promotors are D. A. Belden, F. H. Thatcher and E. B. Mix.

THE WEST MILLVILLE TELEPHONE COMPANY, New Bethlehem, Pa., has been incorporated by R. F. Goss, Samuel Shilling, John F. Mohoney and others. Capital stock, $3000.

THE INTERSTATE EQUIPMENT COMPANY has been incorporated in New York City with a capital stock of $5,000. The directors of the company are John H. Pratt, F. W. Steir, 39 Wall Street, and H. I. Sprague, New York.

THE CHEBOYGAN ELECTRIC LIGHT & POWER COMPANY, Cheboygan, Mich., has been incorporated by Arch McArthur, Chicago, Ill.; Charles E. Mould, William F. DePuy and William S. McArthur. Capital stock, $100,000.

THE NORTHEASTERN RAILROAD COMPANY has been incorporated at Cleveland, O., with a capital stock of $100,000. The incorporators are: Frank S. Lyon, Charles U. Sheldon, William D. Bennett, Gustav Runge and Lafayette Kimball.

THE CONSUMERS' ELECTRIC LIGHT & POWER COMPANY, Newark, N. J., has been organized with a capital stock of $300,000, by Benjamin Atha, Newark; Thomas C. Barr, Orange; Edward L. Conklin, Daniel M. Dill and John L. Pfeifer, Newark, N. J.

THE WAYNE COUNTY TRACTION COMPANY, Lyons, N. Y., has been incorporated to construct and maintain an electric road between Lyons and Newark. The promoters are: A. C. Robertson, Athens, Pa., and Orlando F. Thomas. Capital stock, $60,000.

THE PARK AVENUE STREET RAILWAY COMPANY, Pittsburg, Pa., has been incorporated for the purpose of building an electric street railway along Park and Frankstown Avenues. The promoters are: A. W. Elrius, Pittsburg; James A. McDevitt, Lancaster, and C. I. Magee, Pittsburg. Capital stock, $6000.

Telegraph and Telephone.

HALLETTVILLE, TEX.—George Wilson and others, of Yoakum, have been granted a franchise for a telephone system in this place.

RODMAN, IA.—A new telephone line will be constructed at once between this place and West Bend by the Western Telephone Company.

AVOCA, IA.—The Nebraska Telephone Company will build a line south from Avoca, connecting Hancock, Oakland, Carson and Macedonia.

PAW PAW, MICH.—A company has been organized to build and operate a telephone line between Paw Paw and Watervliet, a distance of 20 miles.

CICERO, ILL.—A franchise has been granted to the Business Men's Association, of Austin, to establish a telephone exchange in this place The association also proposes to install a burglar and fire alarm system.

PLAINVIEW, MINN.—The Plainview-Beaver Telephone Company has decided to extend its line to Conception and Elgin. A line will also be built to Millville and Quincy if sufficient support is given to the enterprise in these two places.

BALTIMORE, MD.—Mayor Hooper has signed the ordinance authorizing a popular vote next November on the question of issuing $100,000 in bonds by the city to pay for a general subway system, the bonds to bear not more than 4 per cent. interest and be redeemable Jan. 1, 1922.

FORT EDWARD, N. Y.—A telephone line will be constructed from Cossayuna village, at the foot of Lake Cossayuna, to Ford Edward, a distance of 14 miles. J. S McClellan, of Cambridge, is interested in the project, and Rodney Van Wormer, of Argyle, will be manager of the line.

NEW YORK, N. Y.—A new cable company has been organized in Germany, with a capital stock of $800,000, to lay a cable between Germany and Spain. It is said that the cable will ultimately be continued to the United States. The name of the new company is the Deutsche Seetelegraphengesellschaft.

Electric Light and Power.

VICKSBURG, MICH.—Bids will be received until Aug. 10 for the construction of the water and light plant.

NEGAUNEE, MICH.—Negaunee is looking towards electric lighting and may control its own plant.

EXETER, N. H.—The Exeter Boot & Shoe Company is arranging to light its large factory with electricity.

OREGON, ILL.—Mr. F. G. Jones will erect a new station for the Oregon Electric Light & Power Company.

OCALA, FLA.—The time for receiving bids for the electric light plant at Ocala has been extended to Aug. 20.

BARNESVILLE, GA.—Seven thousand dollars in bonds will be issued to put in an electric light plant at Barnesville.

HEMPSTEAD, TEX.—The City Council granted a 25 years' franchise to the oil mill owners to erect a system of electric lights.

SANTA MONICA, CAL.—The City Trustees are considering the advisability of municipal ownership of an electric lighting plant.

ALLEGHENY, PA.—Electricity is to be used to furnish motive power for a monster elevator which it is proposed to erect in the lower part of Allegheny.

CARTHAGE, O.—An election will be held Aug. 8, to vote on the issuance of bonds to extend the water and light plant, and the construction of an electric fire alarm.

WATERVILLE, ME.—The Waterville & Fairfield Electric Light & Power Company proposes to build an addition to its power-house and electric plant, at a cost of about $25,000.

NEW LONDON, WIS.—S. A. Sherman sold the electric light plant and franchise to J. L. Haile, of Wausau, the consideration being $10,000. Mr. Haile will make some improvements.

THE NORTH RIVER ELECTRIC LIGHT & POWER COMPANY will erect a one-story brick power-house on Rider Avenue north of One Hundred and Fortieth Street, at a cost of $22,000.

NORTH ABINGTON, MASS.—The Abington & Rockland Electric Light Company will enlarge its plant, and the question of increasing the indebtedness of the company will be considered.

FRANCONIA, N. H.—The residents and hotel proprietors of this place and Sugar Hill have organized an electric light company, and hope to have a complete system of electric illumination in operation next season.

SOUTH ORANGE, N. J.—The Township Committee has decided to make a contract with the People's Electric Light & Power Company, of Newark, to light the township with 30-cp lights one year at $17 per lamp, with the privilege of extending the contract to two years at $16.50 per lamp.

LOWVILLE, N. Y.—The governor of the engine in the electric light plant in this place broke a few nights ago, causing the engine to race. Before it could be stopped the voltage was doubled and considerable damage was done. Most all of the incandescent lamps on the circuit were burned out by reason of the increased pressure.

TOLEDO, O.—Sealed proposals will be received Aug. 20 for the furnishing and installing of the electric light fixtures for the new Lucas County Court House, according to the general plans and specifications prepared by David L. Stine, architect. Bidders may submit designs of their own, based upon the general specifications. Charles H. Jones is County Auditor.

The Electric Railway.

BELMAR, N. J.—The Atlantic Coast Electric Railway Company will endeavor to secure a franchise through Belmar.

BRIMFIELD, MASS.—The people of this place are desirous of building an electric railway connection with Worcester County.

PLAINFIELD, N. J.—The officials of the Plainfield Street Railway Company expect to have the trolley road extended from this city to Scotch Plains.

LEWISTON, N. Y.—The Lewiston & Youngstown Frontier Electric Railway has been opened for service on that portion of the line within the limits of this village.

NEW CASTLE, DEL.—Surveys for the proposed New Castle and Wilmington electric railway are now being made by Engineer George H. F. Wanger, of Pottsville.

ALBANY, N. Y.—The Common Council has given to the Albany, Helderberg & Schoharie Railway permission to enter the city and lay tracks through a number of the streets.

MORRISTOWN, N. J.—Work on the proposed trolley road at Mt. Arlington, Lake Hopatcong, has been postponed until Sept. 18, when it will be hurriedly pushed to completion.

ELIZABETH, N. J.—Steps are on foot for the reorganization of the Elizabeth Street Railway Company, and under the new management electricity will be used for the motive power.

BALTIMORE, MD.—Mayor Hooper signed an ordinance authorizing the Traction Company to lay single or double tracks on Patterson Park Avenue between Baltimore and Fayette Streets.

NEW YORK, N. Y.—The sale of the People's Traction Company's franchise has been postponed until Sept. 14, in order to give the Appellate Division time to pass upon the legal questions involved.

SPRINGFIELD, MASS.—The Street Railway Company has decided to build the extension to Tatham this Summer, and will present a petition to the West Springfield selectmen asking for a location.

SEWAREN, N. J.—The trolley road between Sewaren and Rahway, which is operated by the Union & Middlesex County Electric Light & Power Company, was opened for traffic a few days ago.

GREENBURG, PA.—The Greensburg, Jeannette & Pittsburg Street Railway Company secured the right of way through the Penn Gas Coal Company property, and will begin work at once to complete its lines to Manor.

WORCESTER, MASS.—The Railway Commissioners have approved the terms of lease of the Worcester & Shewsbury Railway and the Worcester & Shewsbury Street Railway to the Worcester Consoldidated Railway Company.

NEW YORK, N. Y.—The Metropolitan Traction Company is seeking consents of property owners to run a line of cars through Forty-third Street and another line through Forty-fourth Street, so as to give it connection with the Grand Central Station.

GREAT NECK, L. I., N. Y.—Several of the wealthy residents of Great Neck are discussing a question of organizing a company for the purpose of building and operating an electric railway between the railway station and the landing at the shore, a distance of two miles. The estimated cost is $30,000.

ALBANY, N. Y.—The Albany Railway Company has applied to the authorities of Colonie for permission to construct a double-track line, a portion of the proposed extension to Cohoes. The route will be to Cohoes, by way of Columbia Street, where a union will be made with the Cohoes City Electric Railway Company's belt line.

WILKINSBURG, PA.—The residents of this place are indignant over the recent inauguration of a 20-cent fare after midnight between Pittsburg and Wilkinsburg, by the Consolidated Traction Company. It is stated that if the company does not amend its action the Borough Council will be asked to remove the car tracks within the Borough limits.

ATLANTA, GA.—Three mischievous boys misplaced a switch on the Decatur line of the Atlanta Consolidated Street Railway Company, resulting in the derailing of a car loaded with passengers. The passengers were considerably shaken up, and their escape from death was regarded as miraculous. Some of them were quite severly injured.

TRENTON, N. J.—Another new trolley road to connect Trenton and Philadelphia has been projected, and its speedy construction, according to the backers of the enterprise, is positively assured. It is to run from Fox Chase, the terminus of one of the Union Traction Company's branch lines, across the country for a distance of about 22 miles to the New Jersey capital.

NEW YORK, N. Y.—It is stated that the New York, Elmsford & White Plains Electric Railway Company has abandoned its original plan of building a trolley line from Elmsford to Tarrytown, and that several prominent citizens of North Tarrytown and Pocantico Hills have started a movement looking towards the construction of an electric road from Tarrytown to North Tarrytown, by way of the Bedford Road to Pleasantville and terminating at Unionville.

JERSEY CITY, N. J.—The Jersey City, Hoboken & Rutherford Electric Railway, which has been blocked for several weeks in Hoboken by the refusal of the Erie & Jersey junction railroads to permit the trolley road to cross their tracks at grade, was permitted a few days ago to continue its work, an agreement having been effected between the belligerents. It is expected that the new trolley line will be in running order within a few days. It is stated that the trolley road will elevate its tracks at the crossing later on.

NEW YORK, N. Y.—The residents of Wakefield, Westchester Village and other localities in the newly annexed district, which comprises the Twenty-Fourth Ward of the city, intend to appeal to the courts as to their rights regarding a five-cent fare to and from Harlem Bridge. They say that when they granted permission to the company to lay its tracks on their property it was with the understanding that the fare was to be only five cents, but that as soon as the cars commenced to run the company began charging 10 cents and has kept it up ever since.

PERSONAL NOTES.

DIED.—W. W. Smith, vice-president and treasurer of the Stillwell-Bierce & Smith-Vaile Company, Dayton, O., died on July 30.

DEATH OF MR. HOGAN.—Mr. John J. Hogan, inventor of the Hogan boiler, died in Middletown, N. Y., on July 30, of Bright's disease. He was born in Ireland and was educated in Dublin and Belgium. His mechanical genius led Sir William Fairchild to apprentice him to the Reading Iron Works in London. Before locating his boiler works in Middletown he resided in New York and St. Louis.

Trade and Industrial Notes.

THE NEWTON MACHINE TOOL WORKS, Philadelphia, Pa., have issued illustrated catalogue No. 32 of their new horizontal boring, drilling and milling machinery.

THE BOSTON BELTING COMPANY, Boston, Mass., has issued a complete catalogue and price list of its India rubber belting and other goods for mechanical purposes.

THE NORTHWEST ENGINEERING COMPANY, dealer in and manufacturer of electrical supplies, St. Paul, Minn., has issued a catalogue and price list of goods handled by it.

DISSOLUTION OF PARTNERSHIP.—The firm of C F. Croselmire & Son, 251 New Jersey Railroad Avenue, Newark, N J., was dissolved on July 28. The business will be continued by C. F. Croselmire, Sr., at the same address.

THE WARD-LEONARD ELECTRIC COMPANY, Hoboken, N. J., is receiving many orders from abroad for its Carpenter enamel rheostats. The orders come from Germany, Switzerland, France, England and Austria, and even Australia.

CHAS. A. SCHIEREN & CO., New York, manufacturers of leather belting, have just received an order from the Stamford Gas & Electric Company for about 115 feet of 50-inch double belting; also from the American Sugar Refining Company for 108 feet of 58-inch three-ply belting. The demand for belting from this firm is reported to be very considerable.

OIL FILTRATION.—The Phœnix Automatic Filter Company, Racine, Wis., has issued a little pamphlet entitled "A Practical Treatise on Oil Filtration." It gives considerable valuable information on the subject, besides describing the Tracy patent filters of all sizes manufactured by this company. These filters are used in many electric light stations and railway power houses.

Business Notices.

The illustrations in this issue were made by the Photo-Engraving Company 67-71 Park Place, New York.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 15 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JULY 28, 1896.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

564,629. ELECTRICAL PROPULSION OF CANAL BOATS; Alonzo C. Mather, Chicago, Ill. App. filed Dec. 1, 1893. In an overhead trolley system, a set of two trolley-wires, hung on the inside of a slotted continuous incasement, combined with a trolley in such a manner that said trolley is guided by the slot in the incasement, which incasement is so arranged as to bear upon and prevent any lateral movement of the trolley.

564,632. ELECTRIC CAR BRAKE; Andrew W. Mitchell, Winthrop, Mass. App. filed Sept. 19, 1895. This consists of the combination of a brake-rod for an electric car or other vehicle, a gear on this rod, a rack-bar arranged to move back and forth in suitable guideways and to engage with and disengage from the gear, a spring arranged to engage with the rack-bar, a shoulder on the rack-bar, and a plate or lug upon the brake-rod or gear arranged to bear upon the rack-bar shoulder to move the rack-bar into engagement with the gear when turning the rod to put on the electric power.

564,638. TROLLEY FINDER; Harrison Ogborn, Indianapolis, Ind. App. filed Jan. 13, 1896. The combination with a trolley and trolley arm, of an electric car, a rod supported by a trolley-arm in the plane of the trolley-groove, and located immediately behind the trolley wheel, with the upper groove of a rod just below the bottom of the groove, at the top of the wheel this rod being incased in a tube, a rope passing downward through the case or tube and attached to a lug at the bottom of another rod, a pulley and a spring enclosed in the case, which withdraws the rod after it has been projected upward while in use.

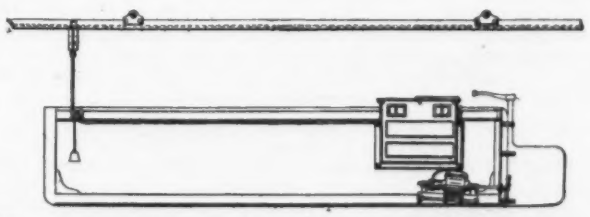
564,652. PASTE-CARRYING PLATE FOR ELECTRIC ACCUMULATORS; Friedrich Wilhelm Schneider, Triberg, Germany. App. filed May 2, 1896. This invention consists of a plate composed of parallel bars, the sides of which are perpendicular to the faces of the plate and are connected each to the next by bridges oblique to the surfaces of the plate, the bridges having respectively on their upper and lower faces parts perpendicular to the face of the plate, and placed at the corners where the bridges connect with the bars.

564,679. BACK CONNECTION FOR SWITCHBOARDS; Alexander J. Wurts, Pittsburg, Pa. App. filed Nov. 7, 1895. The combination with a switchboard back terminal stud, of a plurality of movable devices independently clamped on this stud, the devices having conductor-receiving sockets arranged in a plane substantially parallel to that of the baseboard of the switch.

564,683. ELECTRIC RAILWAY SIGNAL; William Davies, Jersey City, N. J. App. filed April 22, 1896. In an electrically controlled railway signal, a track-circuit, a relay in the track-circuit arranged to be cut out of circuit by the presence of a train on the rails within the circuit, a motor, a motor-circuit closed and opened at the relay, a separable point in the motor-circuit, an automatic time-circuit mechanism to break the separable point in the motor-circuit and arranged to be set by the movement of the signal lever, and an electric circuit to lock and release the time mechanism.

564,702. ALTERNATING CURRENT GENERATOR; Benj. G. Lamme, Pittsburg, Pa. App. filed April 30, 1894. In a polyphase, multipolar generator having a field-magnet and an armature, the number of poles in one of these members being two more than the number of poles in the other, and a closed coil on the armature.

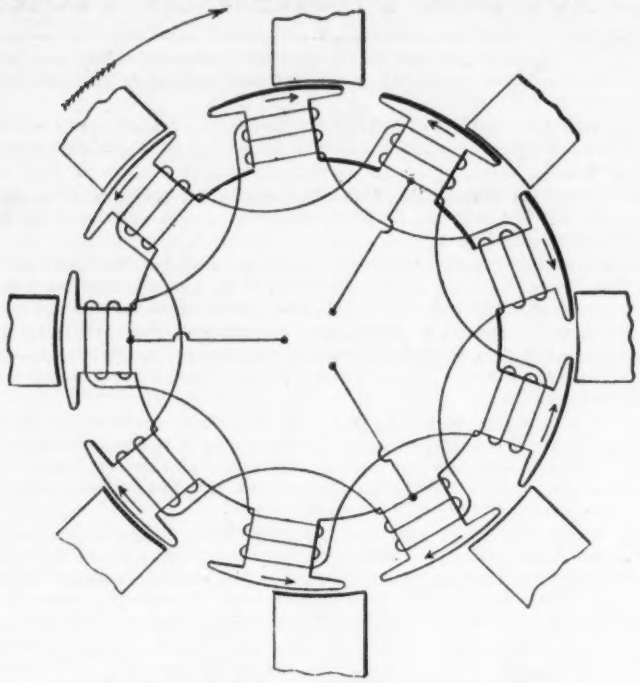
564,703. ALTERNATING-CURRENT GENERATOR; Benj. G. Lamme, Pittsburg, Pa. App. filed June 30, 1894. In a multipolar generator having a radial pole armature, a closed winding making a complete circuit around the armature a number of times equal to the integer nearest the quotient obtained by dividing the number of armature-poles by one half the number of field-magnet poles, and leads connected at equidistant points to the winding.



NG. 563,629.—ELECTRICAL PROPULSION OF CANAL BOATS.

564,706. SIGNALING APPARATUS; Paul Lupke, Trenton, N. J. App. filed May 9, 1895. This invention consists of a signaling apparatus constructed as follows: The combination with an electric current including a signal to be operated, of a circuit-closing device adapted to be supported above the trolley wire of an electric railway, and comprising a base having a slotted extension of non-conducting material, a depending contact-hanger pivoted to the extension, and adapted to be struck by the trolley-wheel, and carrying an arm adapted to project through the slot of the extension, an insulated contact-lever fulcrumed upon the base and normally resting over this slot, and electrical contact-points for closing the circuit when the lever is raised.

564,717. ELECTRICAL SOAP; Herbert E. Rider, New York. App. filed Oct. 8, 1895. This invention comprises a piece of soap with the electrodes of an electric battery placed therein, and two terminals having portions exposed so as to come in contact with the person of the user, the terminals being connected respectively to the electrodes, and the soap being provided with an opening for the access of water to the electrodes.



No. 564,703.—Alternating-Current Generator.

564,723. INCANDESCENT ELECTRIC LAMP FITTING; Eugène F. A. Soleau, Paris, France. App. filed March 19, 1896. A holder for incandescent lamps, comprising an insulating piece provided with an annular groove and a central spring-pressed stem, combined with a conductor laid in the groove and means for engaging the lamp-socket to bind the conductor in the groove by contact of a portion of the lamp socket therewith.

564,743. DYNAMO-ELECTRIC MACHINE AND ELECTROMAGNET; William E. Elliott and John W. Eskholme, Westfield, N. J. App. filed Aug. 26, 1895. An armature having detachable sections and a supporting base, of a spider to which the armature is secured, provided with a toothed segmental shoe resting on the base, a shaft, a pinion for engaging with such toothed shoe, and a bolt and clamp, whereby the armature may be partially rotated as a whole in one or the other direction, when required, and then firmly clamped in place.

564,745. TELEPHONE SYSTEM; Claude C. Gould, Philadelphia, Pa. App. filed July 5, 1895. In a telephone system, the combination with a talking circuit and a ringing or signaling circuit, of an electromagnet arranged in the ringing or signaling circuit, and having an armature, a follower or plunger sliding on a supporting frame, and adapted to carry a push-button or plug forming a visual signal, contacts arranged on the plunger, a contact included both in the talking and ringing circuits, both of the circuit-contacts being arranged in the path of the plunger contacts, a catch controlled by the armature of the electromagnet, whereby the plunger is held in its normal position, and a spring whereby the plunger is forced outward when released.

564,746. ANNUNCIATOR; Claude C. Gould, Buffalo, N. Y. App. filed Sept. 28, 1891. In an annunciator, the combination with a supporting tube and an electromagnet and its armature supported thereon, of a plunger or follower sliding in the tube and carrying a contact, a catch engaging with the plunger and controlled by the armature, a spring for projecting the plunger when released, and terminal contacts arranged in the path of the plunger-contact in front and in the rear thereof, whereby the plunger-contact bears against the rear terminal in the inner position of the plunger and against the front terminal in the outer position thereof.

564,757. CUT-OUT FOR ARC LAMPS; Austin H. Lucas, Pittsburg, Pa. App. filed April 4, 1896. The combination of two movable terminals formed of conducting material and adapted to be connected to the conductors of a feed-circuit, a stationary metal contact-plate arranged in the path of the movement of the terminals, and two terminals formed of conducting material, connected to the lamp and adapted when the lamp is raised to shift the conductor terminals from the contact-plate.

564,771. ELECTRIC ARC LAMP; William C. Armstrong, New York. App. filed Aug. 29, 1895. An electric arc lamp the works of which are provided with an outer and an inner cover, the inner cover being sealed with an upper and lower base, and the outer cover being fitted to slide up and down along the chimney of the lamp.

564,772. ELECTRIC ARC LAMP; William C. Armstrong, New York. App. filed Aug. 29, 1895. An electric arc lamp provided with works, a chimney extending above the works, a chimney cover provided with wireways, a base to support the works, a cover which encloses the works and is closed at its lower end by the base on which the works rest and is free to slide up and down the chimney.

564,792. ELECTRIC METAL-WORKING APPARATUS; Herman Lemp, Lynn, Mass. App. filed Nov. 25, 1892. The combination in an electric metal-working apparatus, of clamps or supports for the work, a number of transformers adapted to feed current to the same piece of work, and movable as to their secondaries into and out of electrical circuit with the work.

564,793. TROLLEY; David Lippy, Ira E. Finfrock, George A. Rinehart and David R. Francis, Mansfield, O. App. filed Sept. 24, 1895. The combination of a pivoted frame, a head pivotally connected thereto and having arms; a block and means for connecting it with the arms by which the block may be adjusted, a rod pivotally connected to the base of the frame, a coil-spring encircling the rod, a cylinder inclosing the spring and rod and attached to the block by suitable flexible connections; whereby the tension of the spring may be changed by the adjustment of the block.

564,794. TROLLEY; David Lippy, Ira E. Finfrock, George A. Rinehart and David R. Francis, Mansfield, O. App. filed Sept. 24, 1895. The combination of a base having a post or upright, a masthead pivoted to the post and having oppositely extending arms, two shafts journaled by the post and by blocks on the base, a crank-arm on each shaft connected with the mast-head-arm, a coiled spring encircling each shaft and connected at one end therewith, and a tube supported by each block that incloses the spring and to which the other end of it is secured.

564,795. TROLLEY; David Lippy, Ira E. Finfrock, George A. Rinehart and David R. Francis, Mansfield, O. App. filed Sept. 24, 1895. The combination of a pivoted mast having oppositely-extending arms, the shaft having two arms that are respectively, rigidly and loosely mounted thereon, the coiled spring around said shaft, having one end connected thereto and the other end connected to the loosely mounted arm, and connections between the arms and the mast-arms.

564,811. SECONDARY ELECTRIC CLOCK; Jasper H. Wilson, Rockwood Tenn. App. filed Jan. 9, 1896. A clock comprising a casing, a series of shelves arranged within the casing, a dial indicating minutes in the front of the casing, a dial indicating hours arranged below the first-named dial, an electromotor mounted on the upper shelf in the casing, a rotary shaft on the next lower shelf and carrying a minute hand, a toothed wheel on the shaft, a push-bar engaging with the wheel and operated by the motor, a cam on the shaft, a lever operated by the cam, means for operating the hour indicator from the shaft, and an electric circuit comprising a battery within the casing.

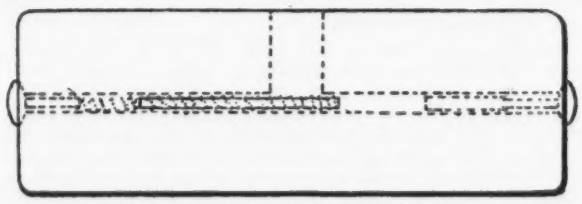
564,858. ELECTRIC METAL SEPARATOR; Harvey H. Whitacre and Andrew C. Wolfe, Wellsville, O. App. filed Nov. 8, 1895. The combination with a conducting-pipe, a series of magnets radiating from the exteriors thereof, and a supporting ring for the magnets, of two series of converging fingers of different lengths, respectively, within the pipe, the fingers of each series being arranged alternately and constituting multiform polar extremities of the magnets.

564,859. ELECTRIC METAL SEPARATOR; Harvey H. Whitacre and Andrew C. Wolfe, Wellsville, O. App. filed Nov. 8, 1895. A metal separating receptacle provided with a series of magnets the poles of which project through the sides thereof, and incline toward one end of the receptacle at oppositely-different angles, a valve and magnets having poles projecting into the receptacle and bent toward the valve to attract the same.

564,864. ELECTRIC TRANSFORMER; Frank L. Sessions, Fort Wayne, Ind. App. filed Sept. 28, 1895. A laminated transformer core comprising an annular or polygonal peripheral portion and three or more inwardly-extending limbs radiating at equal angles about the central axis of the core, each lamina being formed of a plurality of like sheet-metal punchings equal in number to the number of the limbs and having limb-forming tongues interfitting with each other at the centre of the core, the alternate lamina being arranged to break joints.

564,907. ELECTRIC ARC LAMP; Barton B. Ward, New York. App. filed Feb. 15, 1893. In an electric arc lamp, the combination with the support for feed-regulating mechanism of the circuit-breaker and closer placed in the circuit of the feed-regulating derived circuit-coil and directly or indirectly controlled by the support, the circuit closer and breaker being adjusted to normally maintain the circuit but to break the circuit when the arc lengthens.

564,951. ELECTRIC-CURRENT REGULATOR AND DISTRIBUTOR; Arthur H. Washburn, Brockton, Mass. App. filed May 22, 1896. In an electric-current regulator and distributor, a series of insulated resistance bars each connected with a resistance box, a conductor bar connected to the line and located at right angles to the resistance bars and adapted to be electrically connected with any of the resistance bars by a switch, the switch, and a series of bars also at right angles to the resistance bars, electrically connected to the lamps as described, each having a switch adapted to electrically connect with the resistance bars, a generator and electric circuit.



No. 564,717.—Electrical Soap.

564,955. YIELDING AND SELF-ADJUSTING SUPPORT FOR TROLLEY WHEELS; Adolph M. Brunswick and George E. Johnson, Los Angeles Cal. App filed Oct. 7, 1895. A trolley comprising an inner and an outer frame, a trolley wheel journaled in the inner frame, and suitable means connecting the inner and outer frames and arranged to allow the inner frame to partially rotate with relation to the outer frame.